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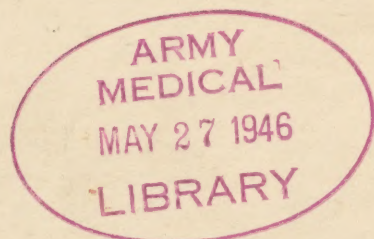
# ARMORED [REDACTED] MEDICAL RESEARCH LABORATORY FORT KNOX, KENTUCKY

INDEXED

PROJECT NO. 7 - NIGHT VISION FROM TANKS

Report On

Sub-Project No. 7-8 - Comparison and Evaluation of Field and  
Laboratory Methods of Measuring Night Visual  
Acuity



#### INFORMATION COPY

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Project No. 7-8

1 May 1944





ARMORED MEDICAL RESEARCH LABORATORY  
Fort Knox, Kentucky

Project No. 7-8  
741-12 SPMEA

1 May 1944

COMPARISON AND EVALUATION OF FIELD AND LABORATORY METHODS  
OF MEASURING NIGHT-SEEING ABILITY OF GROUND TROOPS

1. PROJECT: No. 7 - Night Vision From Tanks; Report on Sub-Project 7-8, Comparison and Evaluation of Field and Laboratory Methods of Measuring Night Visual Acuity.

a. Authority: Letter, Commanding General, Headquarters Armored Force, Fort Knox, Kentucky, 400.112/6 GNOHD, dated September 24, 1942.

b. Purpose: To evaluate the usefulness of various laboratory tests to measure night-seeing ability of ground troops and to choose a test suitable for selection of ground troops for night operations.

2. DISCUSSION:

It is desired to choose from available test methods one which will select men with reasonable accuracy for night-seeing ability for ground night operations. One basis for selection is to test men with the available instruments and to compare these results with the ability to perform visual tasks in the field, the tasks to be of the type normally required of ground troops during night operations. Such a method was employed after preliminary tests indicated that it was possible to devise a field test which could be properly scored and which involved visual tasks of the types normally encountered by ground troops. The instruments and tests compared were AAF Night Vision Tester, Luckiesh-Moss Variable Contrast Charts, S.A.M. Tester, Luminous Plaque and the A.M.R.L. Field Test. Description of test and test equipment and results are given in Appendix.

3. CONCLUSIONS:

a. The AAF night vision tester will enable selection of men for night field operations with sufficient accuracy for practical purposes. The size and cost of the equipment and the requirement of a special dark-room precludes its use in the field or away from well organized training stations.

b. The Luckiesh-Moss variable contrast charts, the S.A.M. tester and certain of the other laboratory tests were less satisfactory.

c. The luminous plaque of the type now under study by Aero-Medical Research Laboratory will allow the selection of men on the basis of night-seeing ability. Little equipment is needed and the device is convenient and



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simple to use. Slight modification in testing technique will improve this test.

4. RECOMMENDATIONS:

a. That the luminous plaque described in appendix be considered satisfactory as a night vision tester for selection of ground troops for night operations.

b. Recommendation for basis of issue and operating procedure for testing are incorporated in a final report now under review.

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APPROVED BY

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4 Incls.

#1 - Appendix

#2 - Table I

#3 - Figs. 1 thru 33

#4 - Photographs 1 thru 12





## DESCRIPTION OF TESTS AND TEST EQUIPMENT

AIRL FIELD TEST

The test was carried out in a large bowl-shaped clearing, approximately 1000 feet by 500 feet, completely surrounded by hills and trees and well away from interfering lights or sky glow. Targets of various size, shape and contrast, tanks, trucks, etc. are placed around and at various distances from each of three stations located in the clearing. (Fig. 1, Table I) The stations are sufficiently far apart so that the targets of one station cannot be seen from the other stations. A white tape, used to guide subjects to and between stations, runs from a starting point in the woods to Station No. 1 thence to Stations No. 2 and No. 3, and continues from the last station into the woods at the far end of the clearing.

Subjects are brought to the area after dark and remain in the woods at the near end of the clearing for at least one half hour for dark adaptation. During this time, the nature of the test and procedure to be followed is explained. Sample targets are shown and the need and methods for using parafoveal vision and scanning are demonstrated.

Three trained operators, one at each station, conduct the test. The first man of the group to be tested follows the white tape from the starting point to station No. 1 where he turns over to the operator a score sheet previously supplied him. He then starts scanning from a point designated by the operator. The subject points out the targets which he sees giving shape and location and noting any further detail, such as a cross or C, seen in the target. If he thinks he sees a vehicle he so states and identifies it if he can do so. He scans through 360°, taking as much time as desired. Three to five minutes is the average time required at each station. The operator records on the data sheet the target number and shape, and notes all description given by the subject. He remains behind the subject and may use a flashlight fitted with red filter while recording data. When finished, the subject is sent to the next station where the same procedure is repeated. After station No. 3 the subject follows the tape to a collecting point where he remains until all men of the group are tested.

Scoring

a. The following procedure was followed:

- (1) If target was not seen--space left blank
- (2) If seen but shape or detail not recognized an X (one point scored)
- (3) If seen and shape described, XX or 2 points
- (4) If seen and shape and distinctive central marking (cross, circle or C) identified XXX or 3 points
- (5) If seen, shape and both kind and full description of central marking are given XXX or 4 points are scored. (by an underline)

Chad #1







b. In case of vehicle:

- (1) If a form is seen but not identified, X or 1 point
- (2) If form is seen and believed to be a vehicle, XX or 2 points
- (3) If identified as as a vehicle, XXX
- (4) If correctly identified as to kind of vehicle, XXX (4 points)

c. For every three wrong answers, without regard to target or sequence, one point is deducted from the total score.

The scores for a test group are collected and tabulated on the forms shown in Figs. 2, 3, 4, etc.

#### AAF TEST

This is an automatic instrument capable of testing six to eight men at one time. The subjects, after indoctrination and after becoming fully dark adapted, are seated before automatic scorers twenty feet in front of an illuminated circular target carrying a Landolt ring subtending one degree at twenty feet. During the test the target appears for seven seconds and disappears for nine seconds then reappears again with the ring in a new position for another seven seconds, etc. During the seven second presentation, the subject attempts to orient the break in the Landolt ring and sets an automatic recorder, which can be adjusted by feel, to a position corresponding to the determined position of the break in the ring. Forty presentations of the target are given with random selection of the ring positions. The first five presentations are given with a background brightness of log 6.25 micro-micro lamberts. The brightness is reduced 0.25 log unit for each succeeding five presentations, making the final brightness log 4.5 micro-micro lamberts.

The score obtained is expressed as the total of the positions determined correctly.

#### LUCKIESH-MOSS

The Luckiesh-Moss Low Contrast Test Chart consists of two rows of two digit numerals on a white background. Subjects are dark adapted for at least thirty minutes before taking this test. There are twenty numerals that decrease uniformly in contrast from 37.8 percent for the first pair to 6.0 percent for the last pair. The chart is illuminated at both 0.0081 foot lamberts and 0.0147 foot lamberts. The subjects are required to read as many digits as possible from a distance of ten feet at both brightness levels. The chart is first read at the low brightness level. The subjects are given as much time as desired. In our tests, three scores were recorded (1) number of correct digits read at low brightness level, (2) number of correct digits read at high brightness level, (3) total digits read at both brightness levels.

#### S.A.M. TESTER

This is an individual threshold-form recognition tester. The target consists of a small radium disc approximately  $1\frac{1}{2}$ " in diameter. In the center of the disc is a Landolt ring approximately  $\frac{1}{2}$ " in diameter. Neutral filters







placed in front of the disc reduce the brightness as desired and the position of the Landolt ring can be changed to any one of four positions. Nine brightness levels are possible--these covering essentially the same range as the AAF tester. The distance of the target from the eye is maintained at approximately 15" by a cord fixed to the instrument and held firmly around the subject's neck. The score is recorded as the lowest brightness level at which consistent recognition of the position of the break in the Landolt ring is made.

### FIELD LANDOLT RING TEST

This test was conducted in the field at night, using a four inch character Landolt ring painted on a white plywood disc twenty-two (22) inches in diameter. The disc was rotated randomly by an operator to one of four positions. The score is taken as greatest distance the subject is consistently able to determine the orientation of the Landolt ring.

### LUMINOUS PLAQUE TESTER

This is an individual threshold-form recognition tester. The target is a circular sodium-salt disc approximately four inches in diameter with a Landolt ring with a diameter of about two (2) inches mounted in the center. The brightness of a background is 0.12 micro lamberts.

The operator holds the plaque five feet in front of the subject, using various orientations. If the subject gets three out of four or six out of eight positions correct the operator moves one foot farther away and continues the test. The distance from the subject to the operator is controlled by a twelve foot cloth tape extending around the subject's neck to the operator. The tape has tabs set at one foot intervals beyond five feet.

The score is expressed in terms of the last distance in feet, at which the subject is consistently able to determine the orientation of the Landolt ring.

### Correlation Between Field and Laboratory Tests

#### PART I - Field Vs. AAF and Luckiesh-Moss Tests

In figures 2, 3, 4 and 5 the individual field test scores of 158 men in groups of 43, 35, 44 and 36 men tested on different nights are given. Tests were conducted on moonless nights only and while the illumination was uniform at about 0.00015 foot candles throughout; the results obtained with different groups are reported separately because of possible slight differences in illumination on the different nights.

The 158 men were also tested in the laboratory with the AAF tester and the Luckiesh-Moss varying contrast charts. The field and laboratory test score distributions are shown in Figs. 6, 7, and 8. Scatter diagrams of the field test scores vs. AAF scores are shown for each group in Figs. 9, 10, 11 and 12. The correlation coefficient between the two scores ( $r$ ), the mean field score ( $\bar{F}$ ), the mean AAF score ( $\bar{MAF}$ ) are given for each group.





In order to establish the practical relationship between the AAF and the Field test, the scatter diagrams were divided with vertical and horizontal percentage lines as shown. The vertical 5% line to the right separates the highest 5% AAF scores from the remaining 95%, the vertical 5% line to the left separates the lowest 5% AAF scores. The two vertical lines then separate the AAF scores into three groups; the highest 5%, the middle 90% and the lowest 5%. In a similar manner the horizontal lines were drawn to separate the field scores into corresponding percentage groups. The two vertical lines and the two horizontal lines for a given percentage then divides the chart into nine rectangles. Points occurring in the upper right hand rectangle, the middle rectangle and the lower left hand rectangle represent agreement between AAF and Field Test. Points occurring in the remaining rectangles represent disagreement and degree of disagreement between the two tests. Dividing the scatter diagrams as shown for various percentages and combining the data for all groups gives points for the construction of Figs. 13 and 14 which summarizes the agreement expected between the AAF and Field test when selection is made on the basis of highest or lowest percentage selected by the AAF test.

For example (Fig. 13) of the 25% highest scores by the AAF test 3% were included in the lowest 25% as rated by the field test, 7% were included in the 50% middle class as rated by the field test and 15% rated highest by both the AAF and field tests.

Similarly (Fig. 14) of the 25% lowest scores by the AAF test 1.5% were included in the 50% middle class as rated by the field test and 11.5% rated lowest by both AAF and Field tests.

Within the limits of definition assigned above, the highest group may be called superior, the middle group average and the lower group poor. This designation assists somewhat in establishing usable corresponding limits for the test.

The following is a summary tabulation of the correlation coefficients of the Field vs. Laboratory Test scores:

<u>Group</u>	<u>No. Men</u>	<u>L.M. Low</u>	<u>L.M. High</u>	<u>L.M. Total</u>	<u>AAF</u>
1	43	.416	.318	.351	.634
2	35	.204	.349	.305	.455
3	44	.499	.381	.411	.626
4	36	.398	.620	.526	.683

It may be seen that in general the AAF test correlates well with the field test procedure and will sort the superior and poorest men reasonably well.

## PART II - Test-Retest of Field and Laboratory tests.

Twenty men were given four field and four laboratory tests with each of the following; AAF and S.A.M. Instruments and the Luckiest-Loss varying contrast charts. They were also given a field Landolt ring test.





For the field test the target distribution was entirely changed between tests to preclude memorizing target locations. Moonless nights only were used and the general illumination was checked each night. The illumination was constant at about 0.00015 foot candles.

Scores obtained on four successive field tests of a group (A) of twenty (20) men are given in Figs. 15, 16, 17 and 18. Correlations between test and retests are given in Table II. Scatter of AAF scores vs. field scores for each test is shown in Figs. 19, 20, 21 and 22. The average score for each man during the four successive field tests as compared with the average for each man of his four successive AAF tests is shown in Fig. 23, similarly mean individual results of field test and of four Luckiesh-loss scores in Figs. 24, 25 and 26, averages for field test vs. average of four S.A.M. tests in Fig. 27 and averages of field test vs. the one field Lamolt ring test in Fig. 28.

TABLE II

Field Test - Retest Correlation Coefficients

Field Test No.	Vs.	Field Test No.	r
1		2	.854
1		3	.856
1		4	.684
2		3	.889
2		4	.904
3		4	.807
Average . . . . .			.832

AAF Test - Retest Correlation Coefficients

AAF Test No.	Vs.	AAF Test No.	r
1		2	.897
1		3	.682
1		4	.843
2		3	.832
2		4	.917
3		4	.944
Average . . . . .			.852





Correlation coefficients of interest are given below:

LUCKIESH-LOSS TEST - TESTS CORRELATION COEFFICIENTS

Luckiesh-Loss High Score No.	Vs.	Luckiesh-Loss High Score No.	r
1		2	.798
1		3	.662
1		4	.729
2		3	.833
2		4	.573
3		4	.245
		Average - - - -	.540

Luckiesh-Loss Low Score No.	Vs.	Luckiesh-Loss Low Score No.	r
1		2	.909
1		3	.598
1		4	.738
2		3	.324
2		4	.491
3		4	.626
		Average - - - -	.641

Luckiesh-Loss Total Score No.	Vs.	Luckiesh-Loss Total Score No.	r
1		2	.849
1		3	.630
1		4	.774
2		3	.819
2		4	.845
3		4	.893
		Average - - - -	.806





# FIELD VS. LABORATORY TEST CORRELATION COEFFICIENTS

		r		
Average 4 Field Tests	Vs.	Av. AAF	.769 (See Fig. 23)	
		Av. L.M. High	.711 ( " " 24)	
		Av. L.M. Low	.769 ( " " 25)	
		Av. L.M. Total	.709 ( " " 26)	
		Av. S.A.M.	.508 ( " " 27)	
		1st L.M. High	.708	
		2nd L.M. High	.663	
		3rd L.M. High	.440	
		4th L.M. High	.705	
		1st L.M. Low	.832	
		2nd L.M. Low	.774	
		3rd L.M. Low	.440	
		4th L.M. Low	.862	
		1st L.M. Total	.785	
		2nd L.M. Total	.750	
		3rd L.M. Total	.473	
		4th L.M. Total	.801	
		1st S.A.M.	.823	
		Field Landolt Ring	.714 (See Fig. 28)	
Field Test No. 1	Vs.	L.M. High - No. 1	.400	
		L.M. Low - No. 1	.571	
		L.M. Total - No. 1	.469	
Field Test No. 2	Vs.	L.M. High - No. 2	.402	
		L.M. Low - No. 2	.617	
		L.M. Total - No. 2	.556	
Field Test No. 3	Vs.	L.M. High - No. 3	.623	
		L.M. Low - No. 3	.541	
		L.M. Total - No. 3	.629	
Field Test No. 4	Vs.	L.M. High - No. 4	.724	
		L.M. Low - No. 4	.755	
		L.M. Total - No. 4	.753	
Field Test	Vs.	S.A.M. Test	r	No. of Men
1		1	.451	20
2		2	.495	20
3		3	.216	19
4		4	.595	17





PART III - This section considers the Luminous Plaque Test scores in relation to Field and AAF test scores. Fig. 29 shows scatter of Luminous Plaque scores vs. Field scores for one test each for sixty-four (64) men. Fig. 30 shows scatter of Luminous Plaque scores vs. AAF scores for one test each for one hundred twenty-five (125) men. Fig. 31 shows scatter of individual averages for four Luminous Plaque scores vs. averages for four AAF Test scores for each of twenty-five (25) men. It also shows the scatter for the first Luminous Plaque Test vs. the last AAF test for this group. Test-Retest and other correlation coefficients of interest are tabulated below:

Field Test No.	Vs.	Luminous Plaque Test No.	r	No. of Men
1		1	.640	16
2		2	.597	25
3		3	.553	23
AAF Test	Vs.	Luminous Plaque Test	.789	125 (See Fig. 30)

#### LUMINOUS PLAQUE TEST - RETEST CORRELATION COEFFICIENTS

(54 Men)

Luminous Plaque Test No.	Vs.	Luminous Plaque Test No.	r
1		2	.662
1		3	.640
1		4	.644
1		5	.631
2		3	.694
2		4	.744
2		5	.632
3		4	.723
3		5	.660
4		5	.765
Average - - - - -			.680

Figs. 32 and 33 show the percentages of high, middle and low by field test for selected percent high or low by the luminous Plaque test, determined in the same manner as for the AAF-Field Tests in Part I.





TABLE 1

## SIZE AND BRIGHTNESS OF FIELD TARGETS

<u>Target No.</u>	<u>Shape-Size (inches)</u>	<u>Brightness (foot lamberts)</u>
1	Square 21.5 x 21.5	$26 \times 10^{-6}$
2	Circle 17 $\frac{1}{2}$ " diameter	20
3	Circle 22" "	55
4	Triangle 32 x 32 x 32	27
5	Circle 66" diameter	60
6	Circle 17.5 "	31
7	Circle 17.5 "	90
8	Triangle 32 x 32 x 32	30
11	Circle 45" diameter	31
12	Square 21.5 x 21.5	18
13	Circle 22" diameter	38
15	Circle 22" "	85
16	Circle 45" "	50
17	Square 21.5 x 21.5	45
19	Circle 66" diameter	65
20	Rectangle 30 x 36	60
21	Circle 45" diameter	40
22	Circle 45" "	65
23	Triangle 32 x 32 x 32	40
24	Circle 22" diameter	75
26	Square 21.5 x 21.5	50
27	Ambulance	9.5
28	Tank, M4	19
30	Circle 22" diameter	19
32	Rectangle 30 x 36	16
33	Triangle 32 x 32 x 32	31
34	Circle 66" diameter	75
35	Rectangle 30 x 36	45
36	Circle 22" diameter	47
37	Square 21.5 x 21.5	30
38	Triangle 32 x 32 x 32	22

TABLE 1





FIG. 1

PLAN OF AMRL NIGHT VISION FIELD TEST RANGE SHOWING  
DISTRIBUTION OF TARGETS ABOUT OBSERVATION POINTS

DISTANCES IN FEET, SIZE, BRIGHTNESS AND CONTRAST OF TARGETS GIVEN IN TABLE 1.

STATION NO. 3



STATION NO. 2



STATION NO. 1



FIG. 1





# INDIVIDUAL FIELD TEST SCORES

## GROUP I

(43 MEN)

SUBJECTS																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	SCORE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	69
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58	
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58		
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58			
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58				
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58					
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58						
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58							
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58								
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58									
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58										
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58											
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58												
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58													
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58														
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58															
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																		
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																			
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																				
22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																					
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																						
24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																							
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																								
26	27	28	29	30	31	32	33	34	35	36	37	38	39	58																									
27	28	29	30	31	32	33	34	35	36	37	38	39	58																										
28	29	30	31	32	33	34	35	36	37	38	39	58																											
29	30	31	32	33	34	35	36	37	38	39	58																												
30	31	32	33	34	35	36	37	38	39	58																													
31	32	33	34	35	36	37	38	39	58																														
32	33	34	35	36	37	38	39	58																															
33	34	35	36	37	38	39	58																																
34	35	36	37	38	39	58																																	
35	36	37	38	39	58																																		
36	37	38	39	58																																			
37	38	39	58																																				
38	39	58																																					
39	58																																						
40	58																																						
41	58																																						
42	58																																						
43	58																																						

43 MEN

FIG. 2





GROUP 2

## SUBJECTS

44  
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77  
78

F16. 3

35 MEN

Incl #3





### GROUP 3

## SUBJECTS

44 MEN

FIG. 4





## GROUP 4

36 MEN

[illegible]

Fig. 5

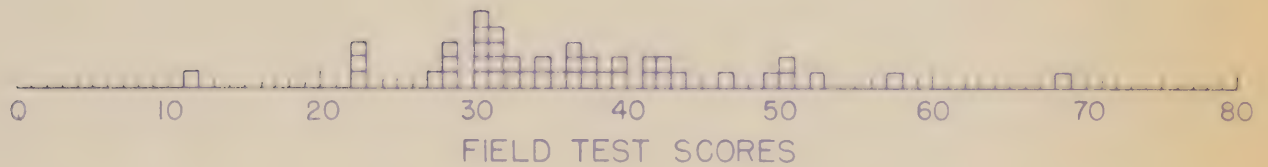
Incl # 3



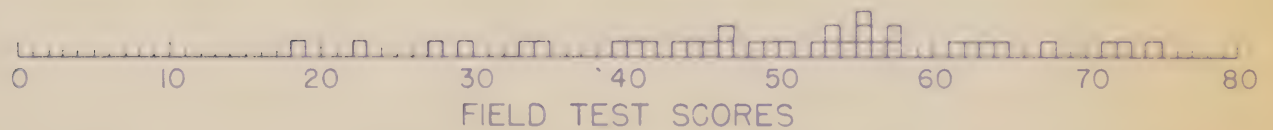
FIG. 6

HISTOGRAM SHOWING  
DISTRIBUTION OF FIELD TEST RESULTS  
WITH VARIOUS GROUPS

GROUP 1 - 43 MEN



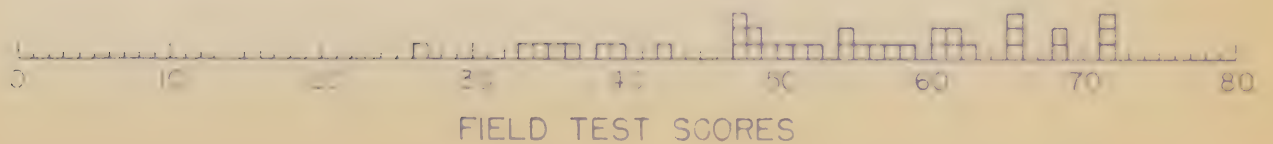
GROUP 2 - 35 MEN



GROUP 3 - 44 MEN



GROUP 4 - 36 MEN



EACH SQUARE = 1 MAN

FIG. 6

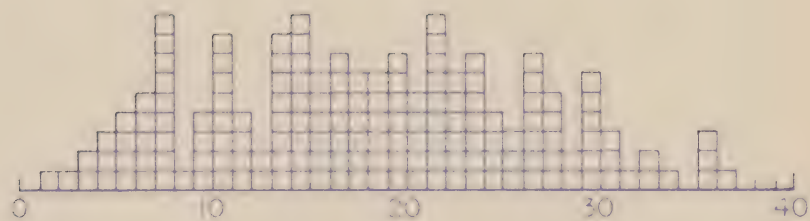




FIG. 7

HISTOGRAM SHOWING  
DISTRIBUTION OF A.A.F. SCORES

ALL GROUPS COMBINED



158 MEN

EACH SQUARE = 1 MAN

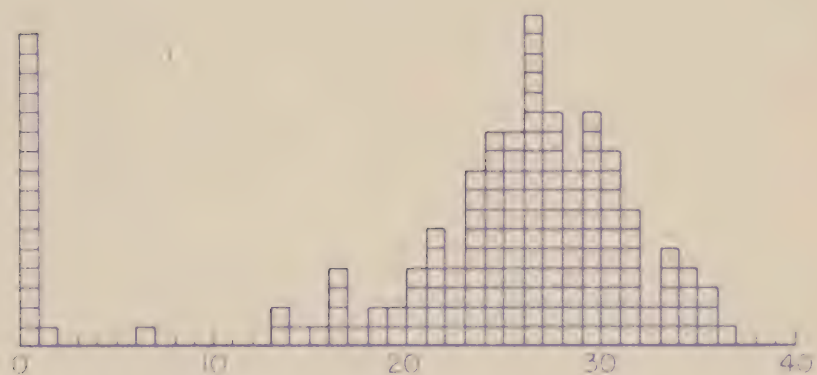
FIG. 7



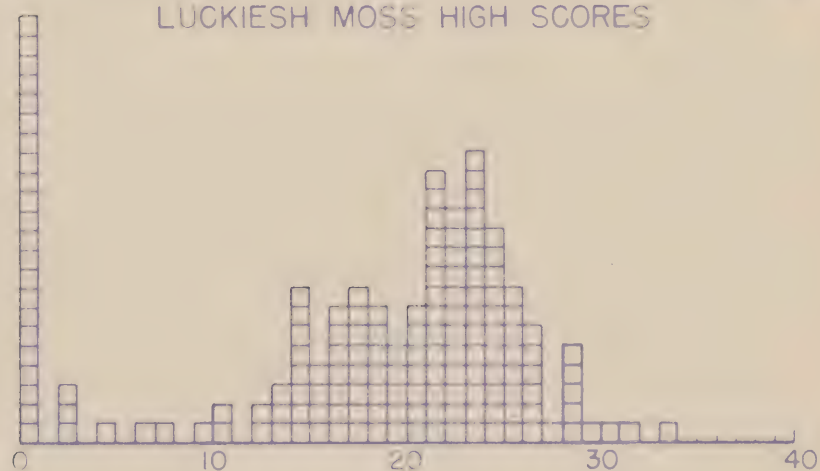


FIG. 8

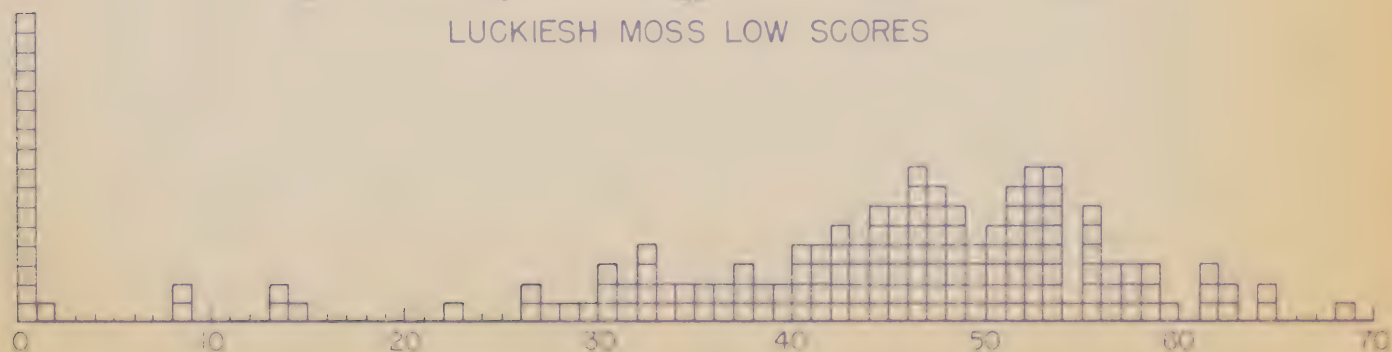
HISTOGRAMS SHOWING  
DISTRIBUTION OF LUCKIESH MOSS SCORES  
ALL GROUPS COMBINED



LUCKIESH MOSS HIGH SCORES



LUCKIESH MOSS LOW SCORES



LUCKIESH MOSS TOTAL SCORES

158 MEN    EACH SQUARE = 1 MAN

FIG. 8

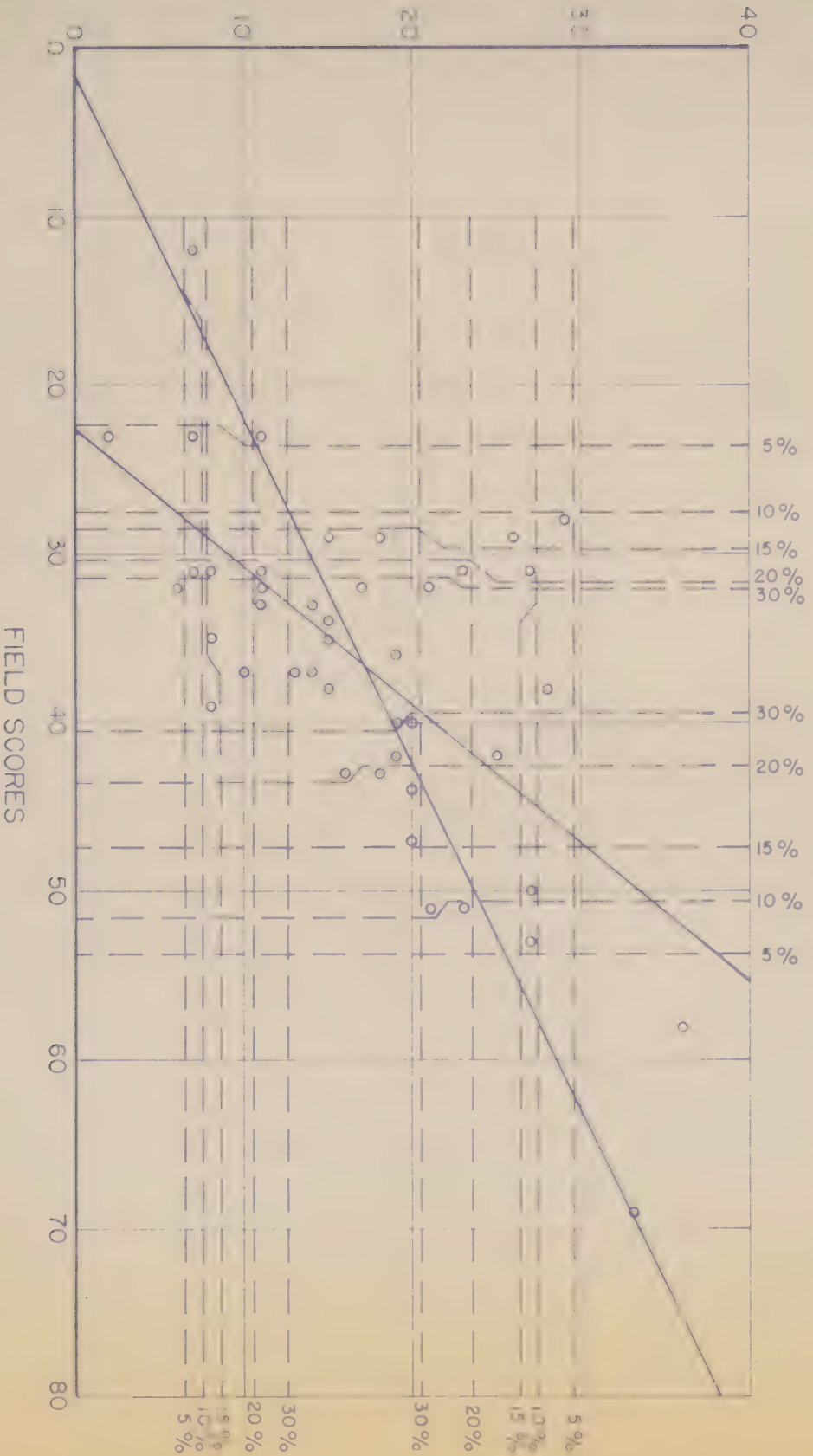


FIG. 9

SCATTER DIAGRAM SHOWING CORRELATION  
BETWEEN FIELD SCORES AND A.A.F. SCORES

GROUP I

( PERCENTILE DISTRIBUTION OF SCORES BY BOTH TESTS INDICATED )



$r = 0.634$   
M.F. = 36.83  
M.A.A.F. = 17.21

FIG. 9



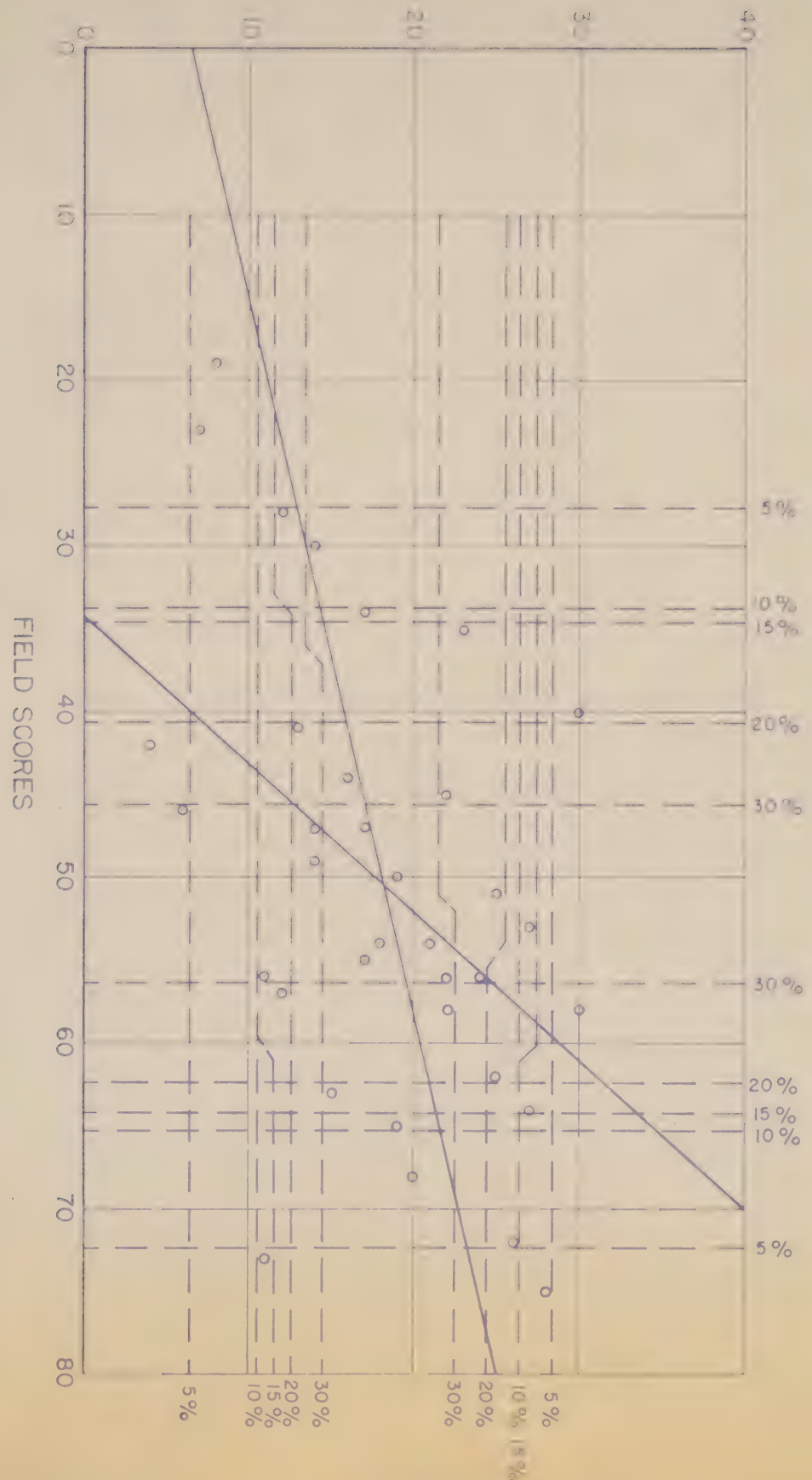


FIG. 10

SCATTER DIAGRAM SHOWING CORRELATION  
BETWEEN FIELD SCORES AND A.A.F. SCORES

GROUP 2

( PERCENTILE DISTRIBUTION OF SCORES BY BOTH TESTS INDICATED )



$r = 0.455$   
 $MF = 50.57$   
 $MAAF = 18.17$

FIG. 10



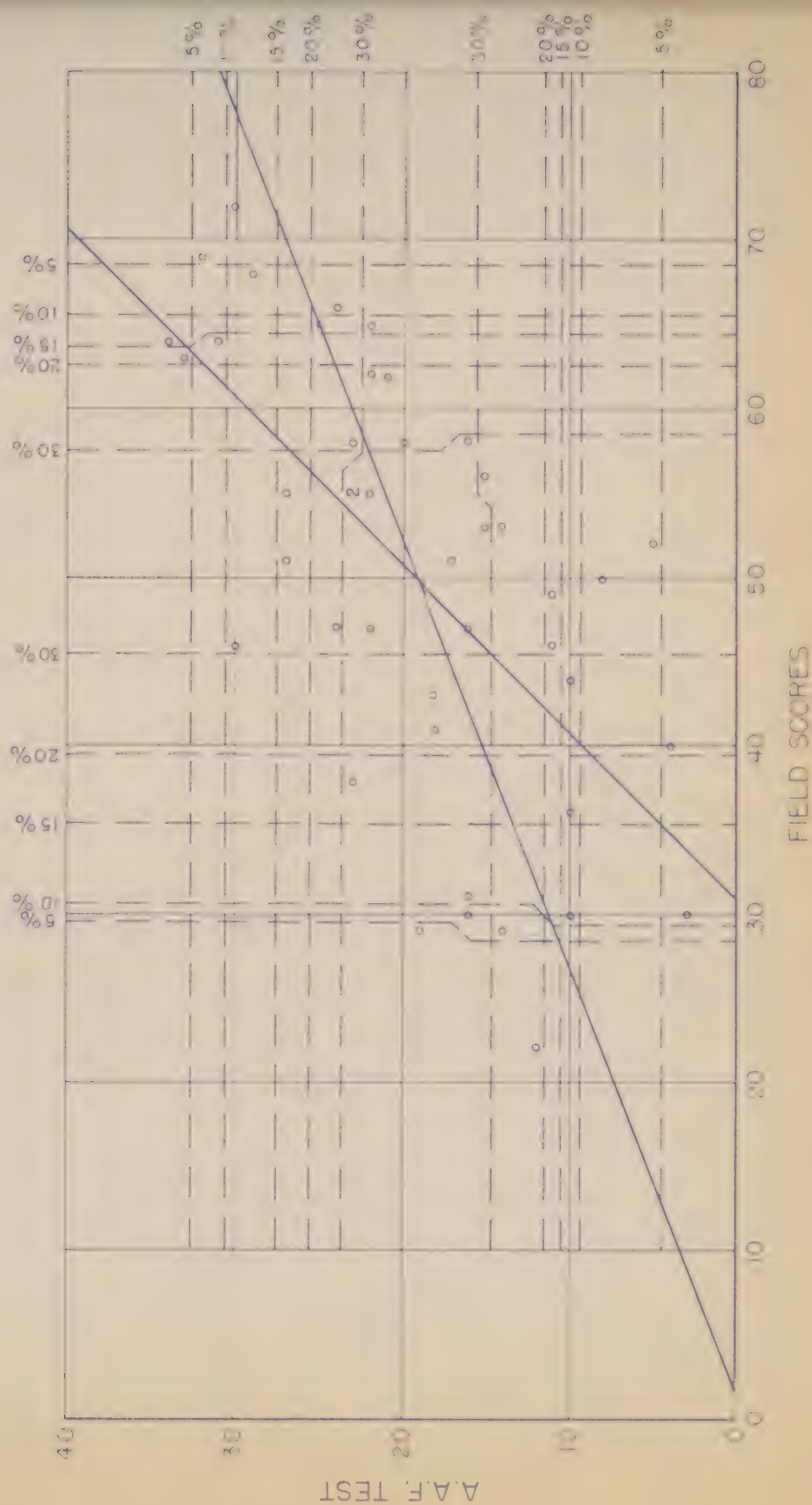


FIG. 11

# SCATTER DIAGRAM SHOWING CORRELATION BETWEEN FIELD SCORES AND A.A.F. SCORES

## GROUP 3

( PERCENTILE DISTRIBUTION OF SCORES BY BOTH TESTS INDICATED )



$r = 0.626$   
 $MF = 49.86$   
 $MAAF = 19.04$

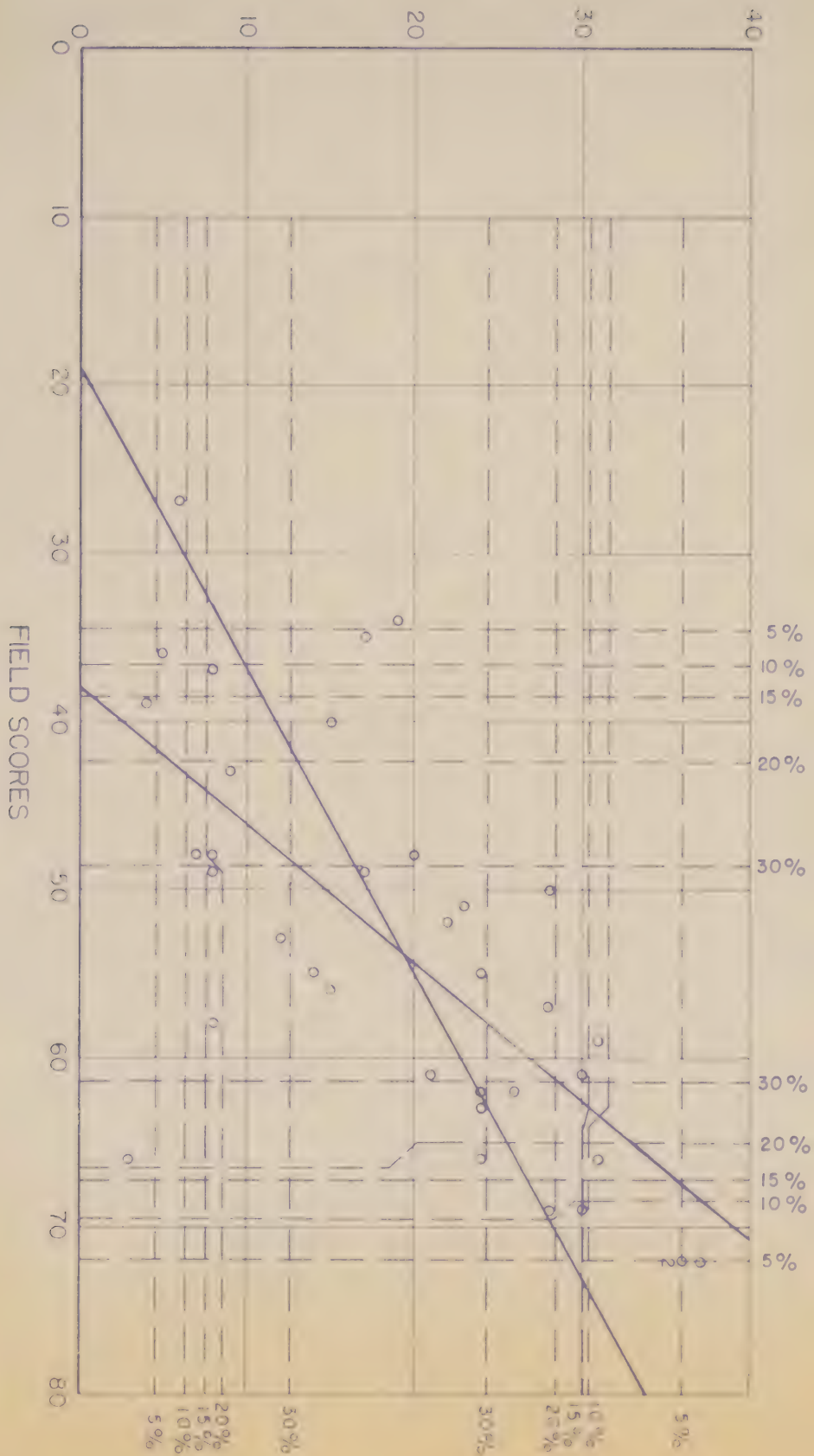


FIG. 12

SCATTER DIAGRAM SHOWING CORRELATION  
BETWEEN FIELD SCORES AND A.A.F. SCORES

GROUP 4

( PERCENTILE DISTRIBUTION OF SCORES BY BOTH TESTS INDICATED )



$r = 0.683$   
 $MF = 53.88$   
 $MA.A.F. = 19.38$

FIG. 12





FIG. 13

PERCENT HIGH, MIDDLE AND LOW BY FIELD TEST  
FOR SELECTED HIGHEST PERCENT BY A.A.F. TEST

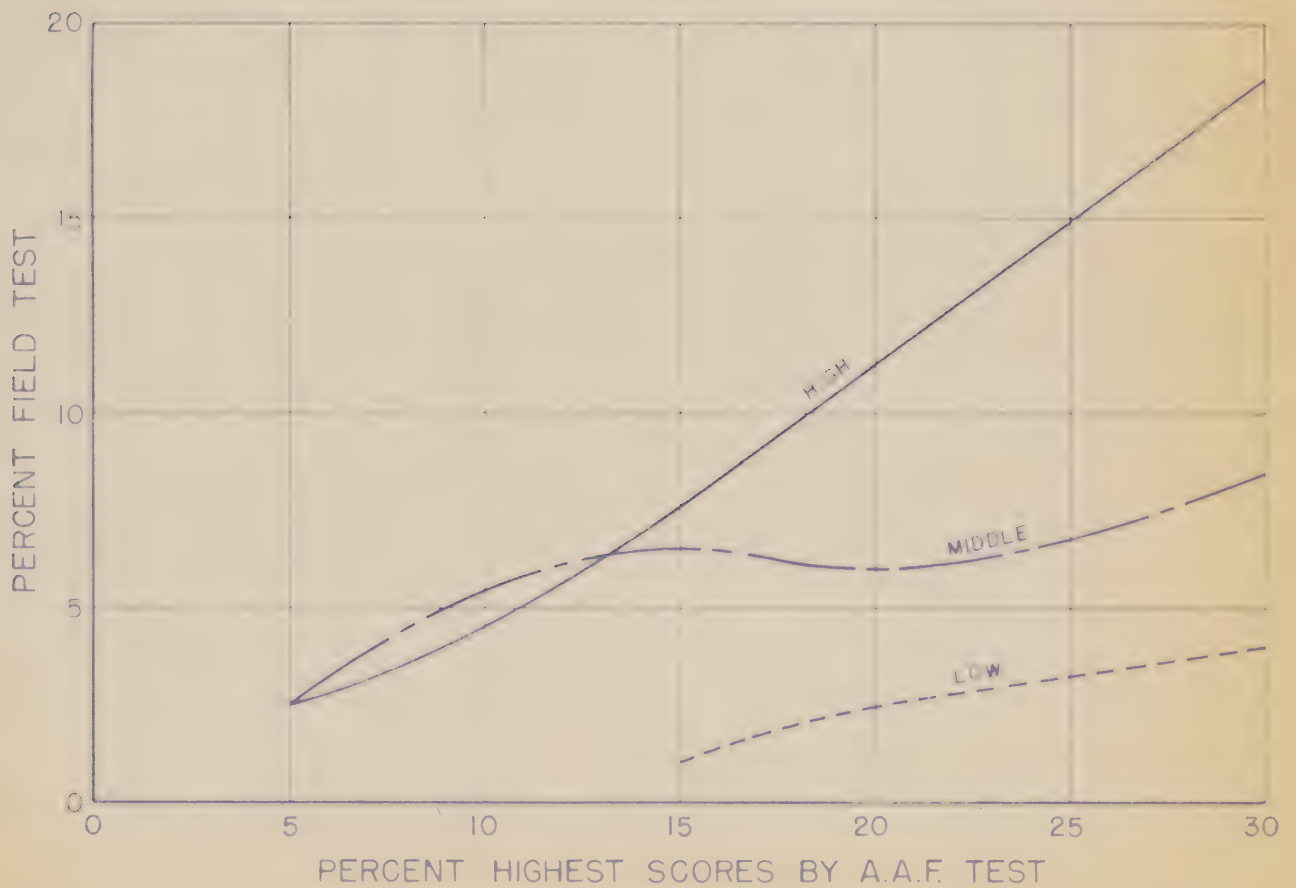


FIG. 13





FIG. 14

PERCENT LOW, MIDDLE AND HIGH BY FIELD TEST  
FOR SELECTED LOWEST PERCENT BY A.A.F. TEST

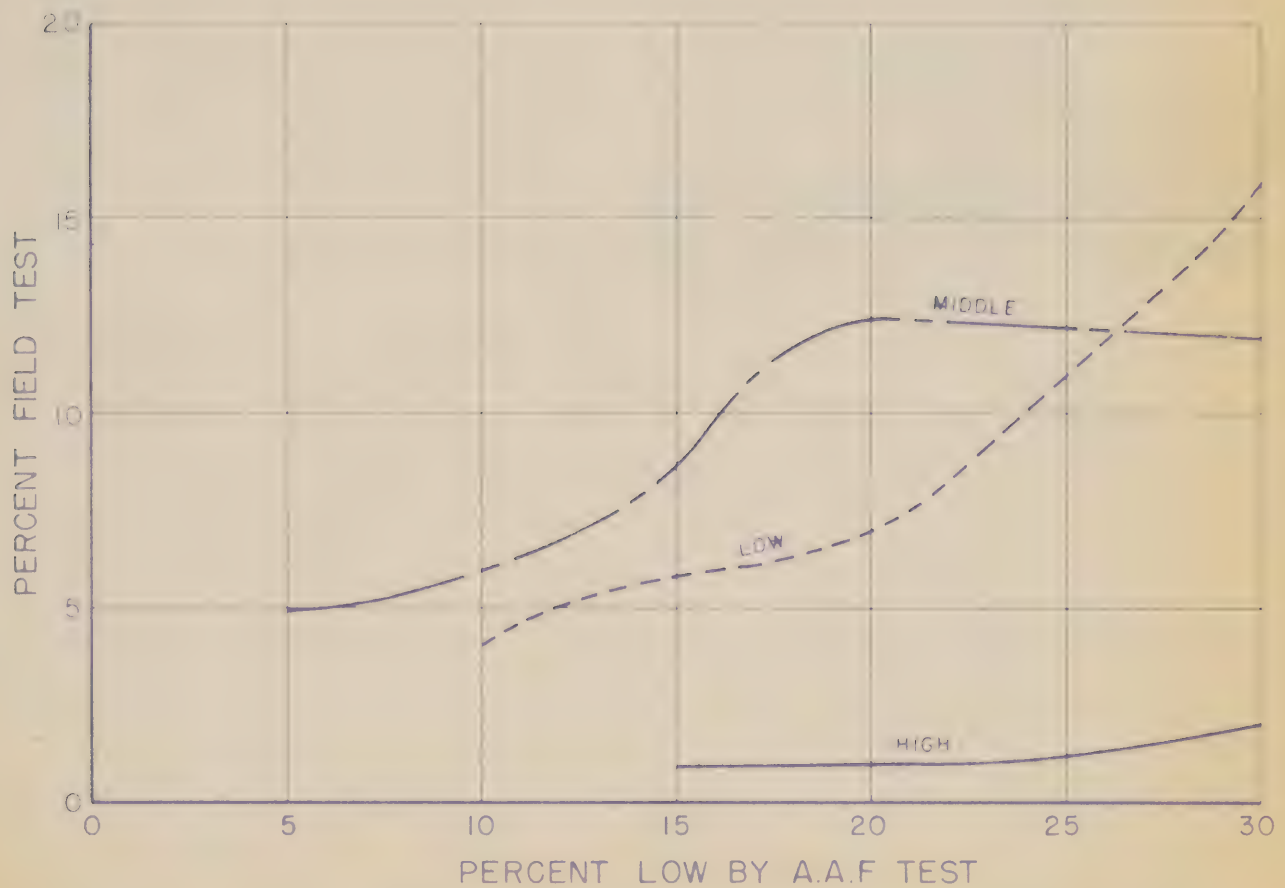


FIG. 14



# RESULTS OF INITIAL TEST OF GROUP A

## TEST I

(20 MEN)

SUBJECTS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377	1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394	1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411	1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428	1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445	1446	1447	1448	1449	1450	1451	1452	1453	1454	1455	1456	1457	1458	1459	1460	1461	1462	1463	1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474	1475	1476	1477	1478	1479	1480
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## TEST 2

3

FIG. 16





# TEST 3

3

FIG. 17





# TEST 4

53

FIG. 18



FIG. 19

SCATTER DIAGRAM SHOWING RELATIONSHIP BETWEEN  
FIELD SCORES AND A.A.F. SCORES FOR GROUP A  
FIRST TEST

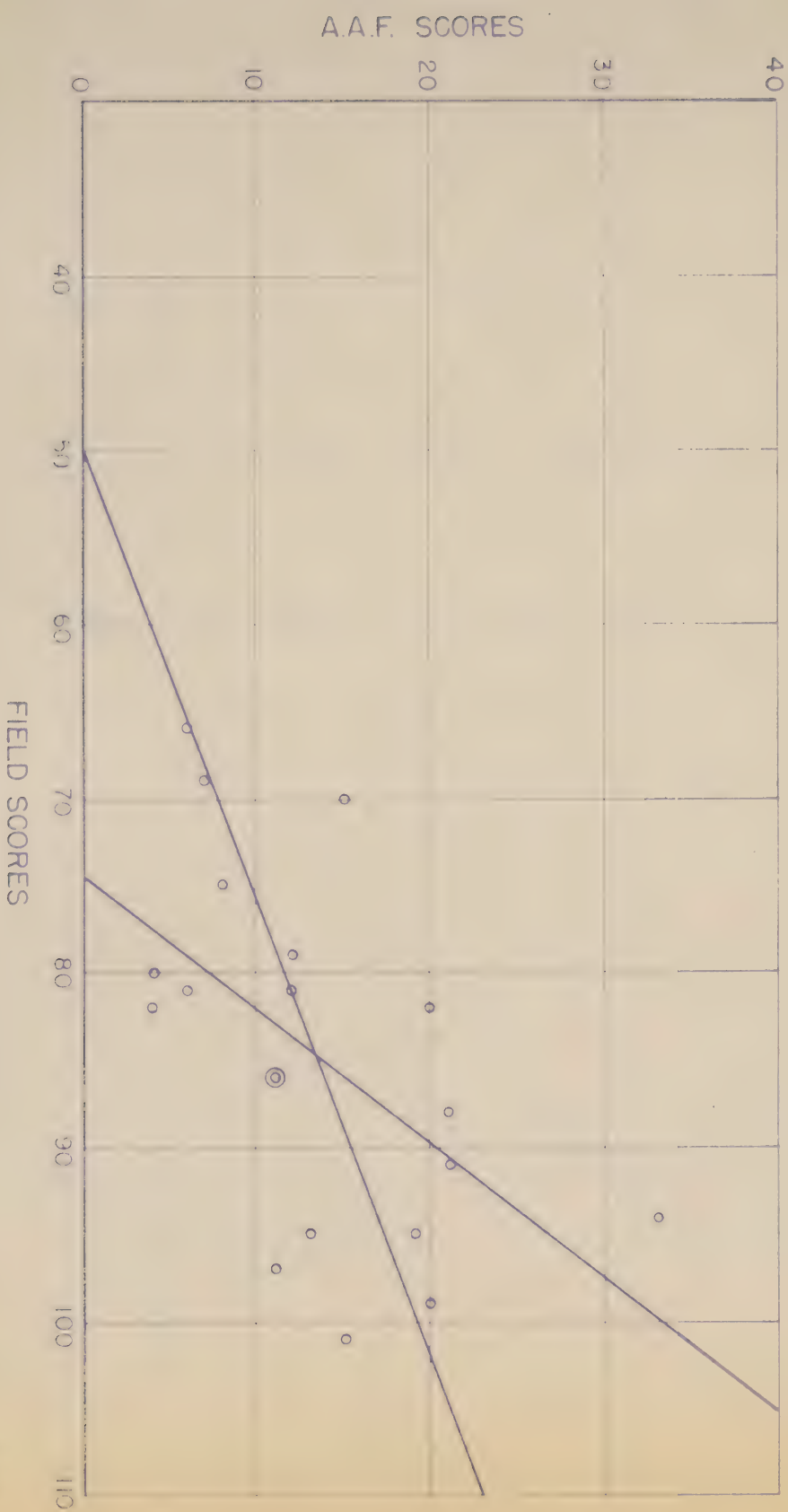


FIG. 19

$r = 0.536$   
 $M_F = 184.85$   
 $M_{A.A.F.} = 13.43$





FIG. 20

SCATTER DIAGRAM SHOWING RELATIONSHIP BETWEEN  
FIELD SCORES AND A.A.F. SCORES FOR GROUP A  
SECOND TEST

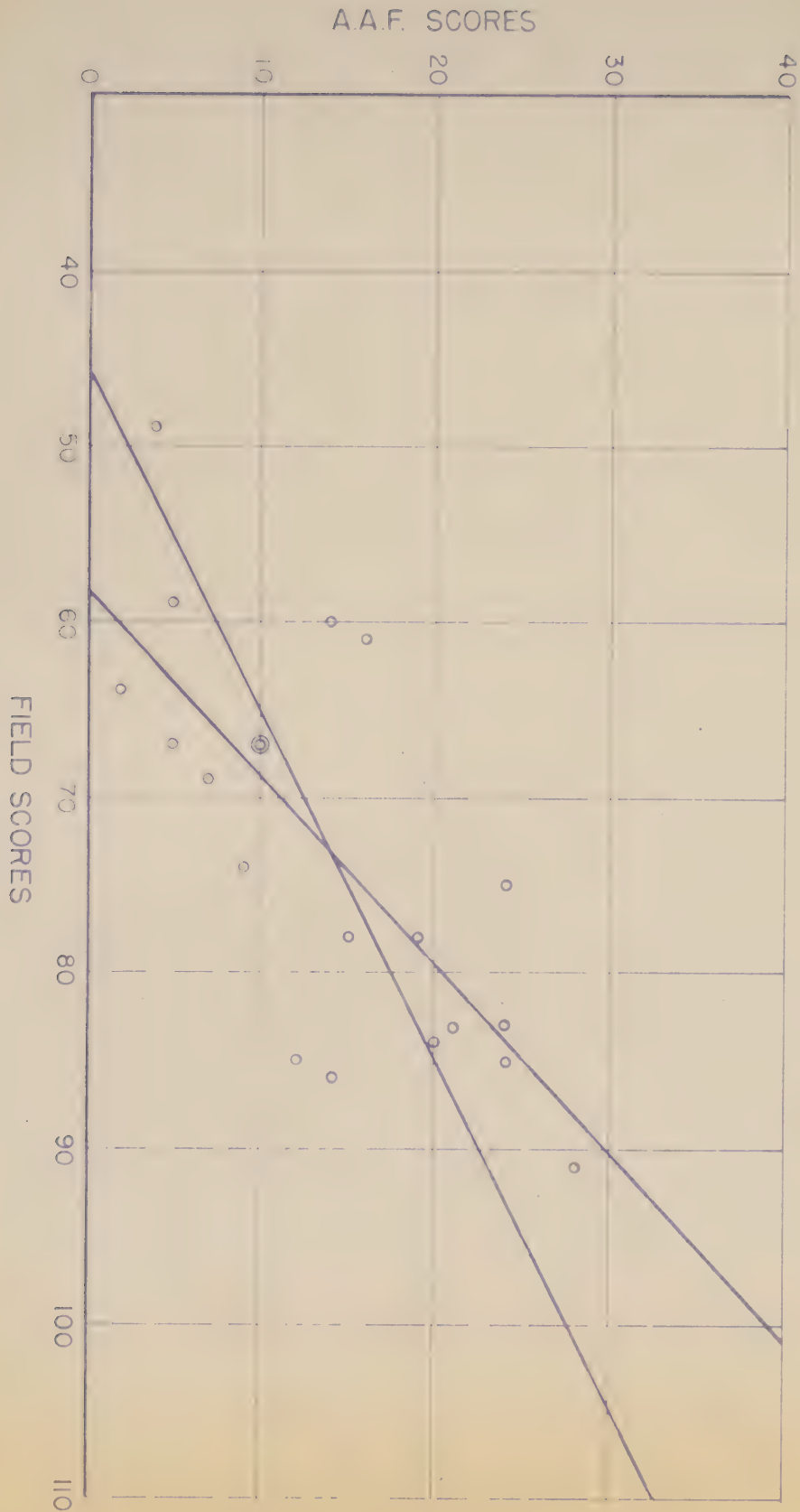


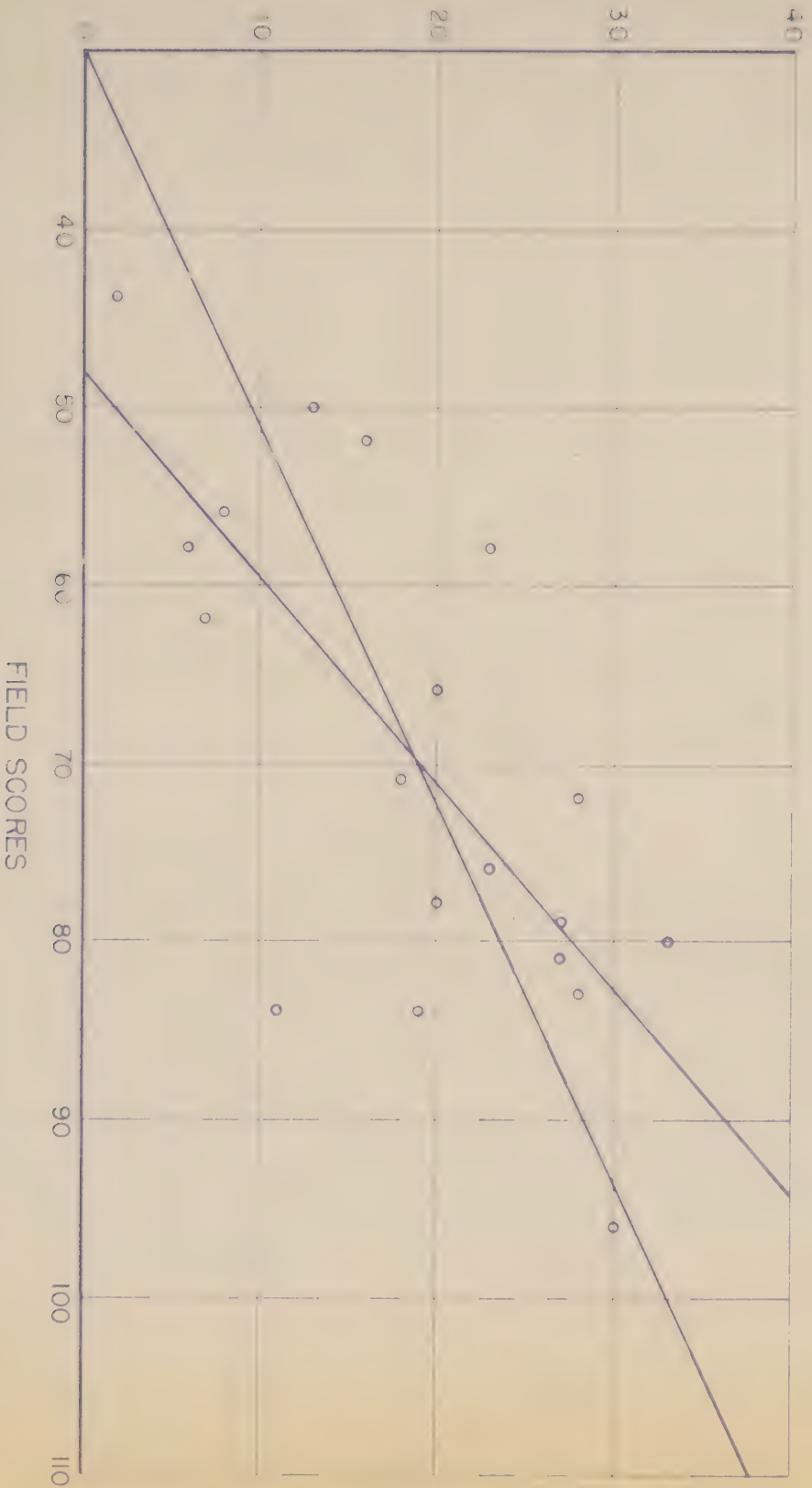
FIG. 20





FIG. 21

SCATTER DIAGRAM SHOWING RELATIONSHIP BETWEEN  
FIELD SCORES AND A.A.F. SCORES FOR GROUP A  
THIRD TEST



$r = 0.741$   
MF = 70.00  
MA A.F. = 18.89

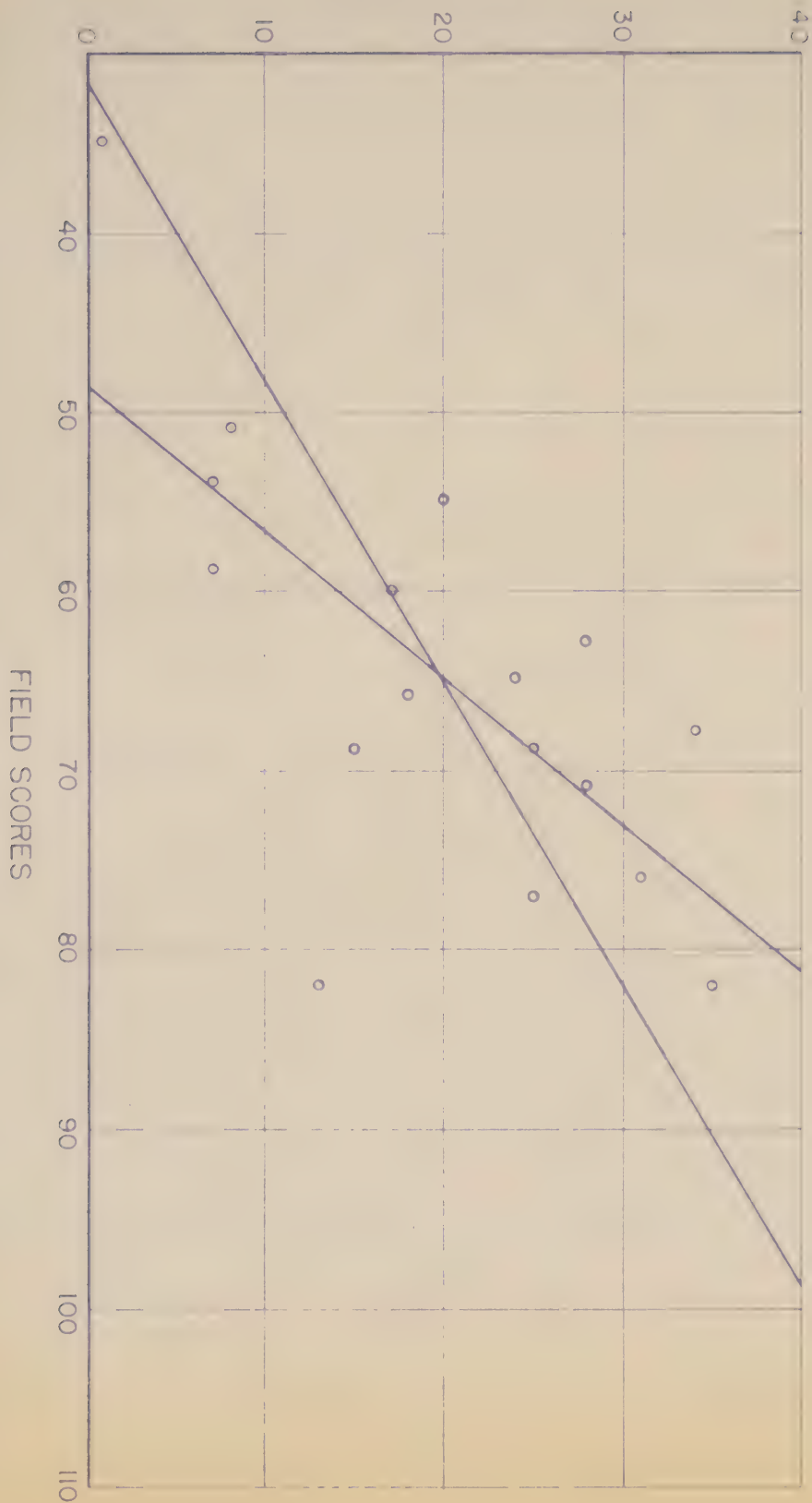
FIG. 21



FIG. 22

SCATTER DIAGRAM SHOWING RELATIONSHIP BETWEEN  
FIELD SCORES AND A.A.F. SCORES FOR GROUP A

FOURTH TEST



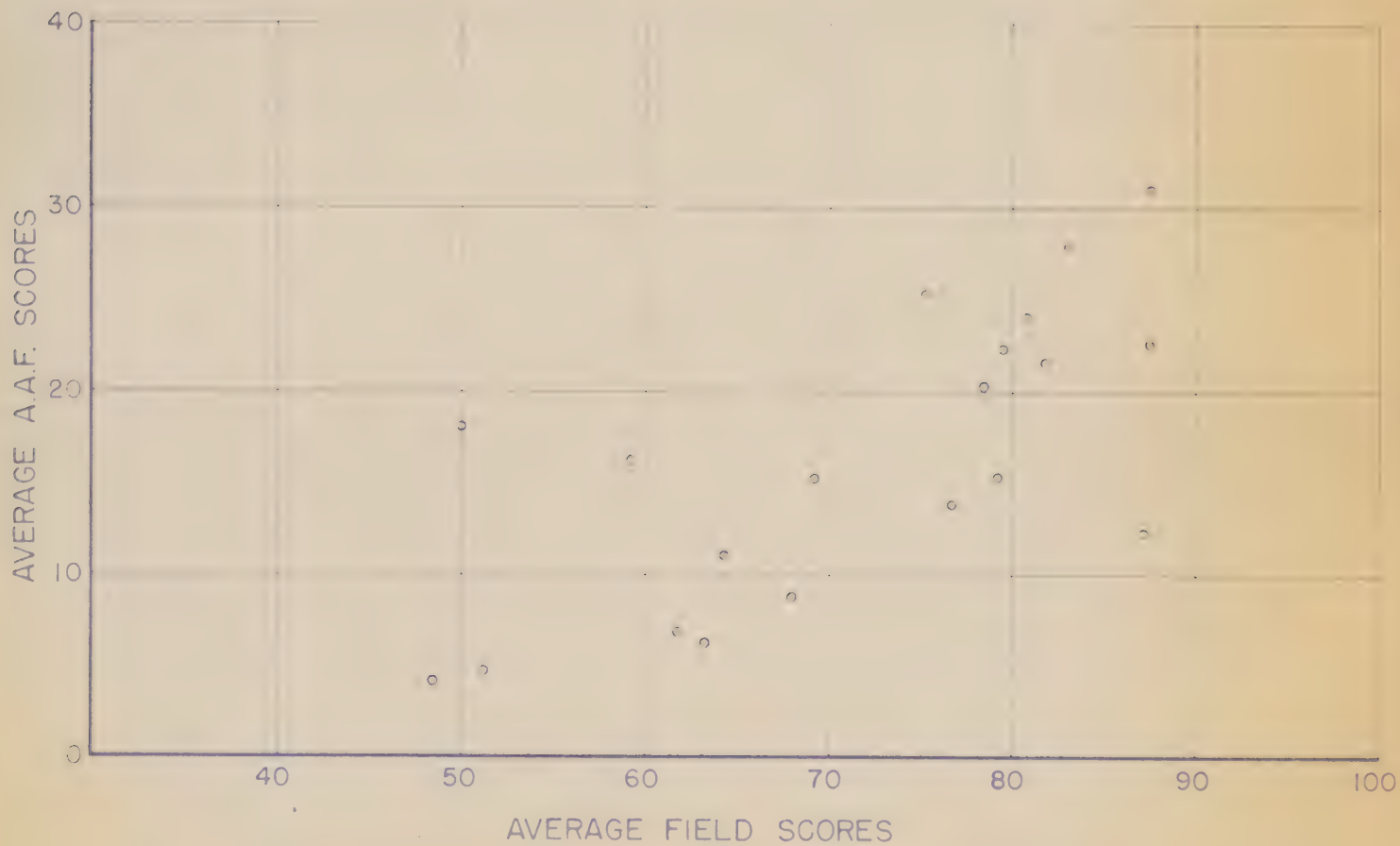
$r = 0.698$   
 $M.F. = 64.82$   
 $M.A.F. = 19.76$





FIG. 23

COMPARISON OF THE AVERAGES OF FOUR SUCCESSIVE FIELD  
SCORES OF INDIVIDUAL MEN WITH THEIR AVERAGES FOR FOUR  
SUCCESSIVE A.A.F. TESTS



Sheet 43

FIG. 23



FIG. 24

COMPARISON OF THE AVERAGES OF FOUR SUCCESSIVE FIELD  
SCORES OF INDIVIDUAL MEN WITH THEIR AVERAGES FOR FOUR  
LUCKIESH MOSS TESTS (0.0147 FT. LAMBERTS)

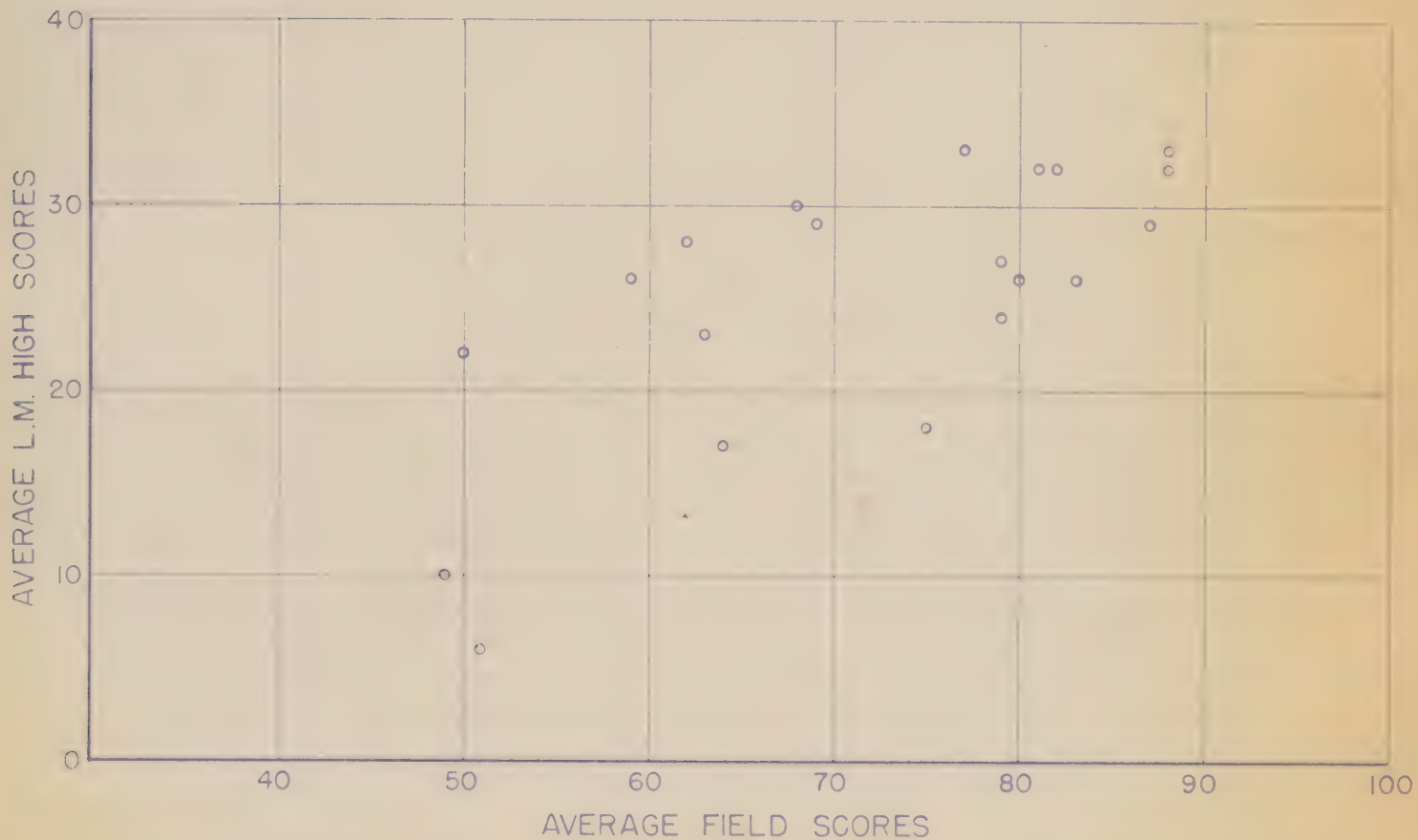


FIG. 24





FIG. 25

COMPARISON OF THE AVERAGES OF FOUR SUCCESSIVE FIELD  
SCORES OF INDIVIDUAL MEN WITH THEIR AVERAGES FOR FOUR  
LUCKIESH MOSS TESTS (0.0081 FT. LAMBERTS)

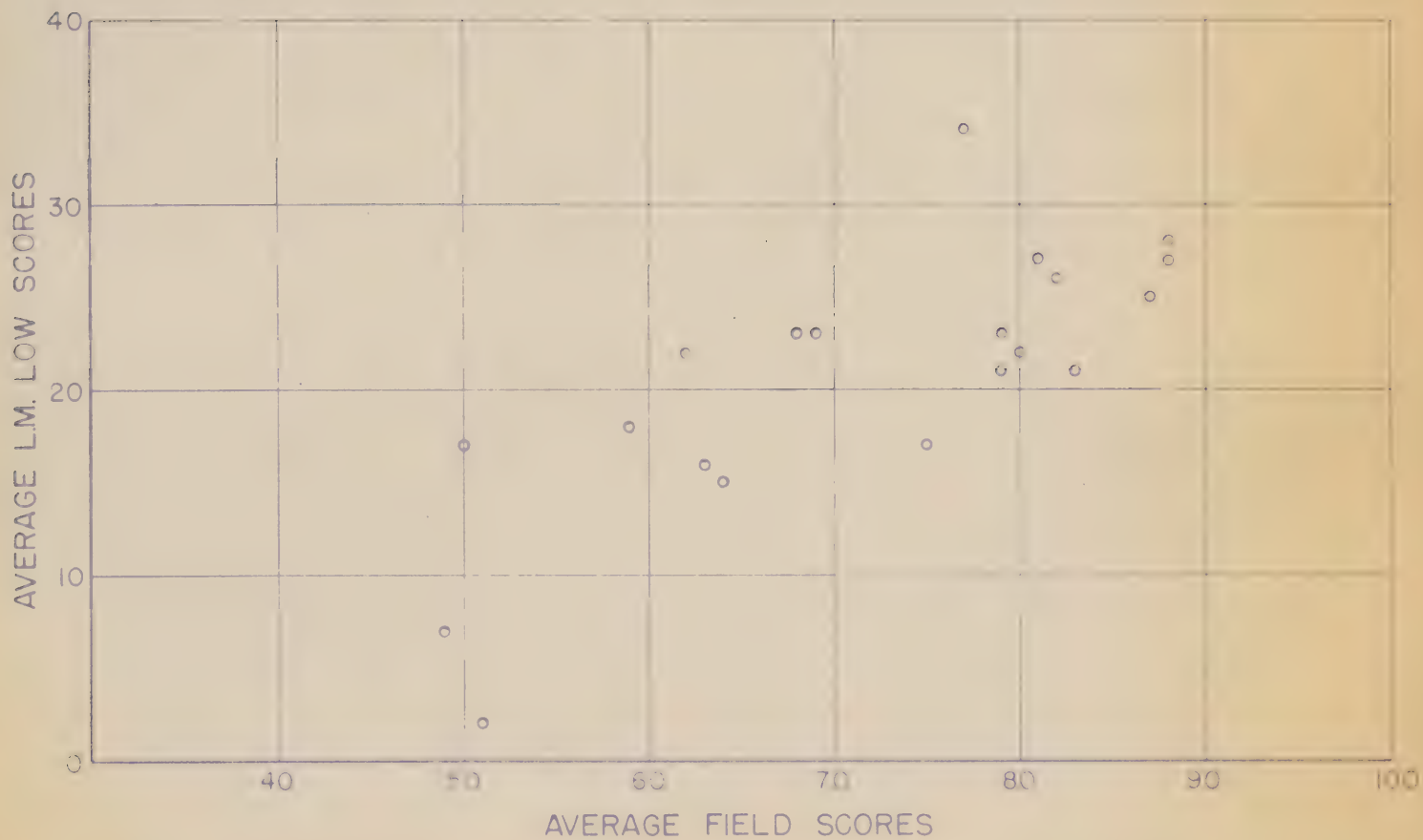


FIG. 25



FIG. 26

COMPARISON OF THE AVERAGES OF FOUR SUCCESSIVE FIELD  
SCORES OF INDIVIDUAL MEN WITH THEIR AVERAGES FOR FOUR  
LUCKIESH MOSS TESTS

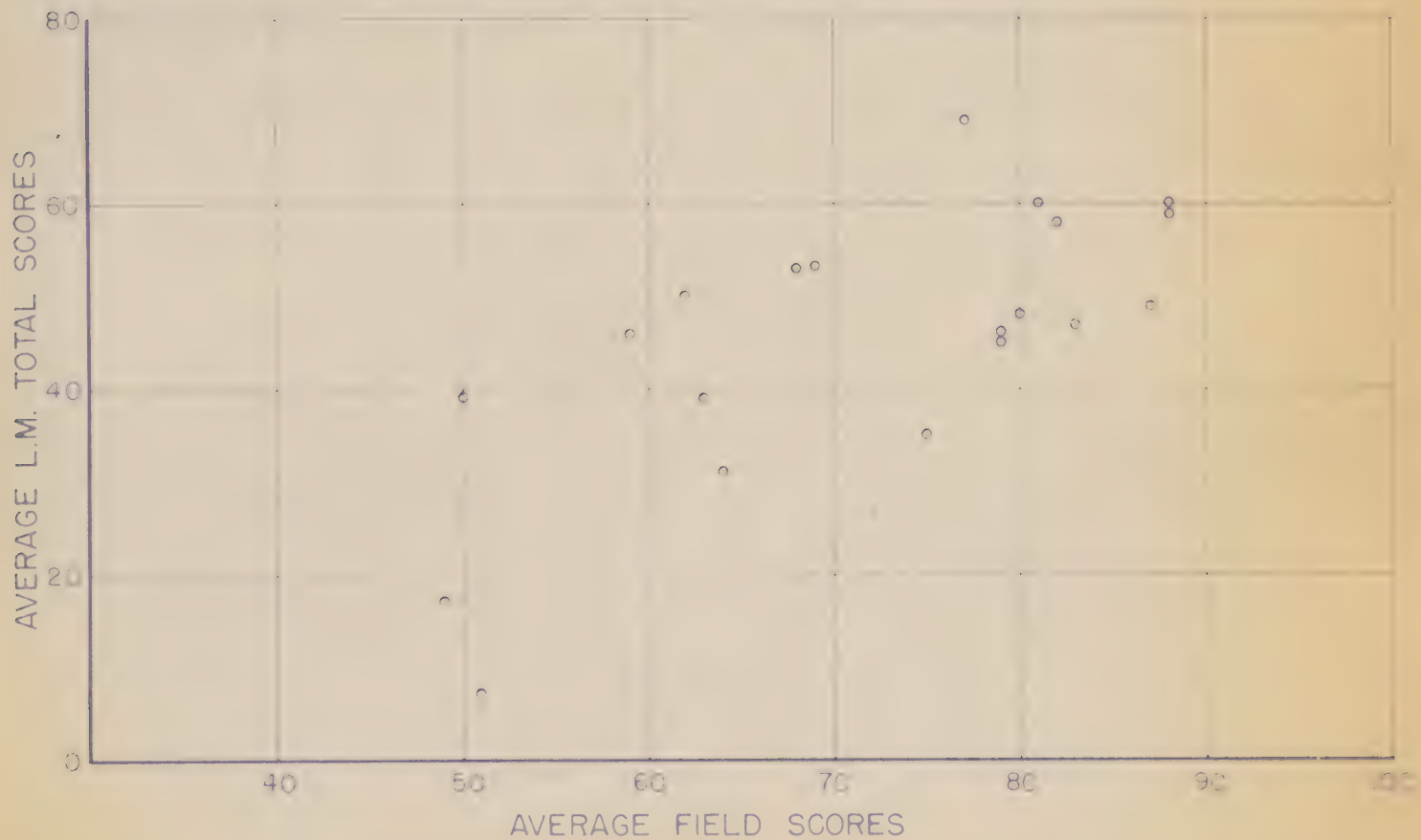


FIG. 26





FIG. 27

AVERAGE FIELD SCORES VS. AVERAGE S.A.M. SCORES

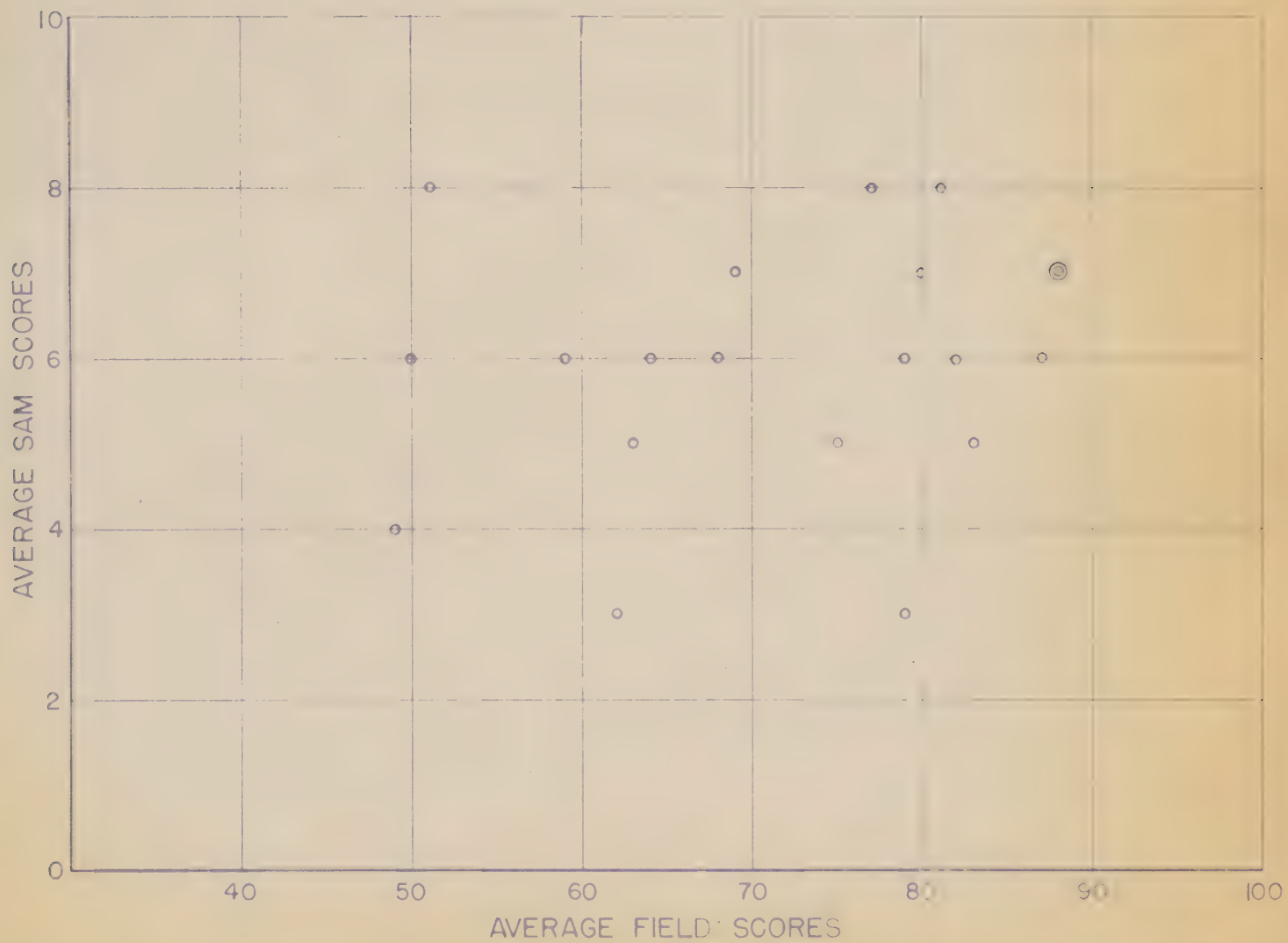




FIG. 28

AVERAGE FIELD SCORES VS. LANDOLT RING FIELD SCORES

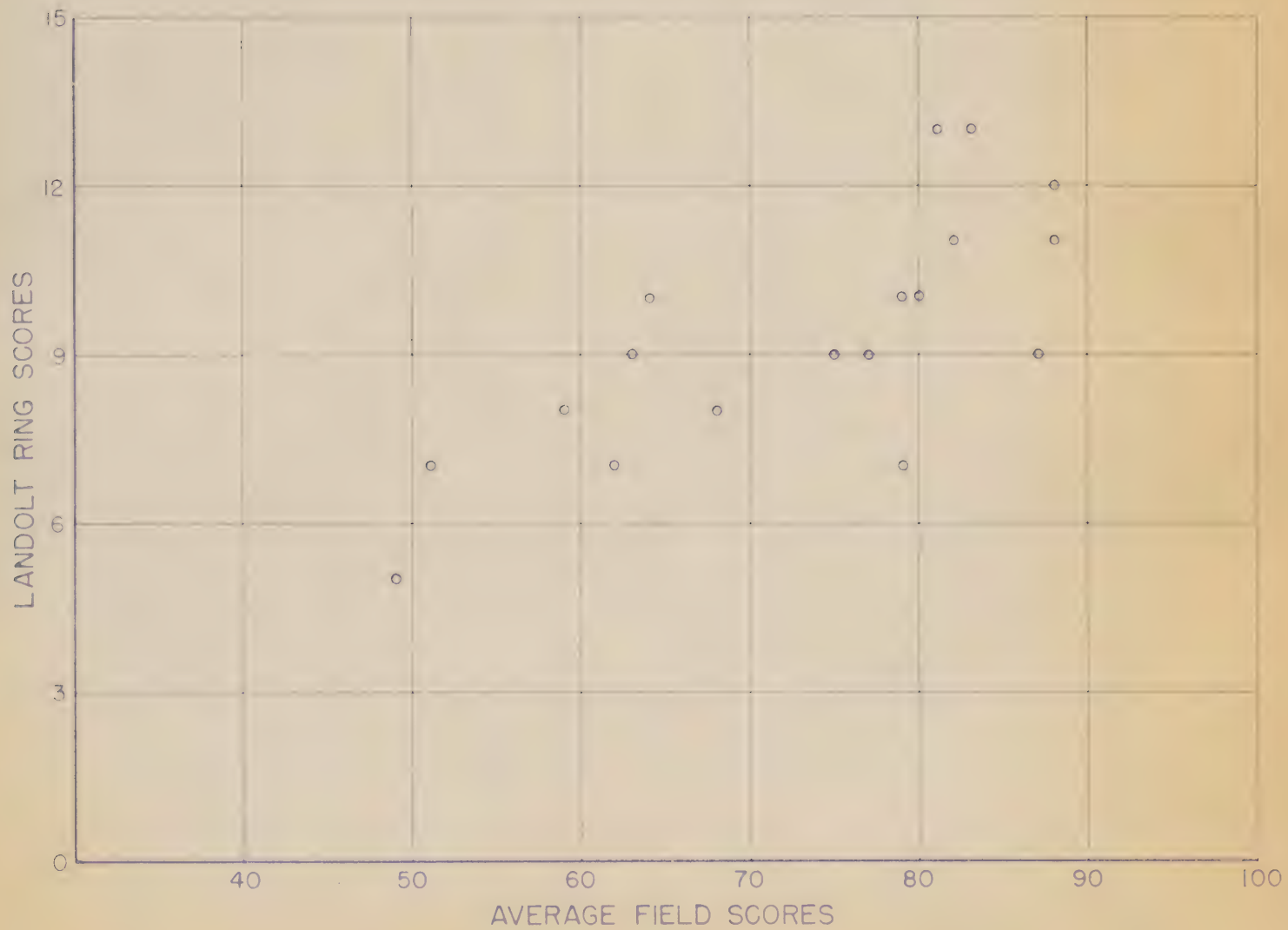


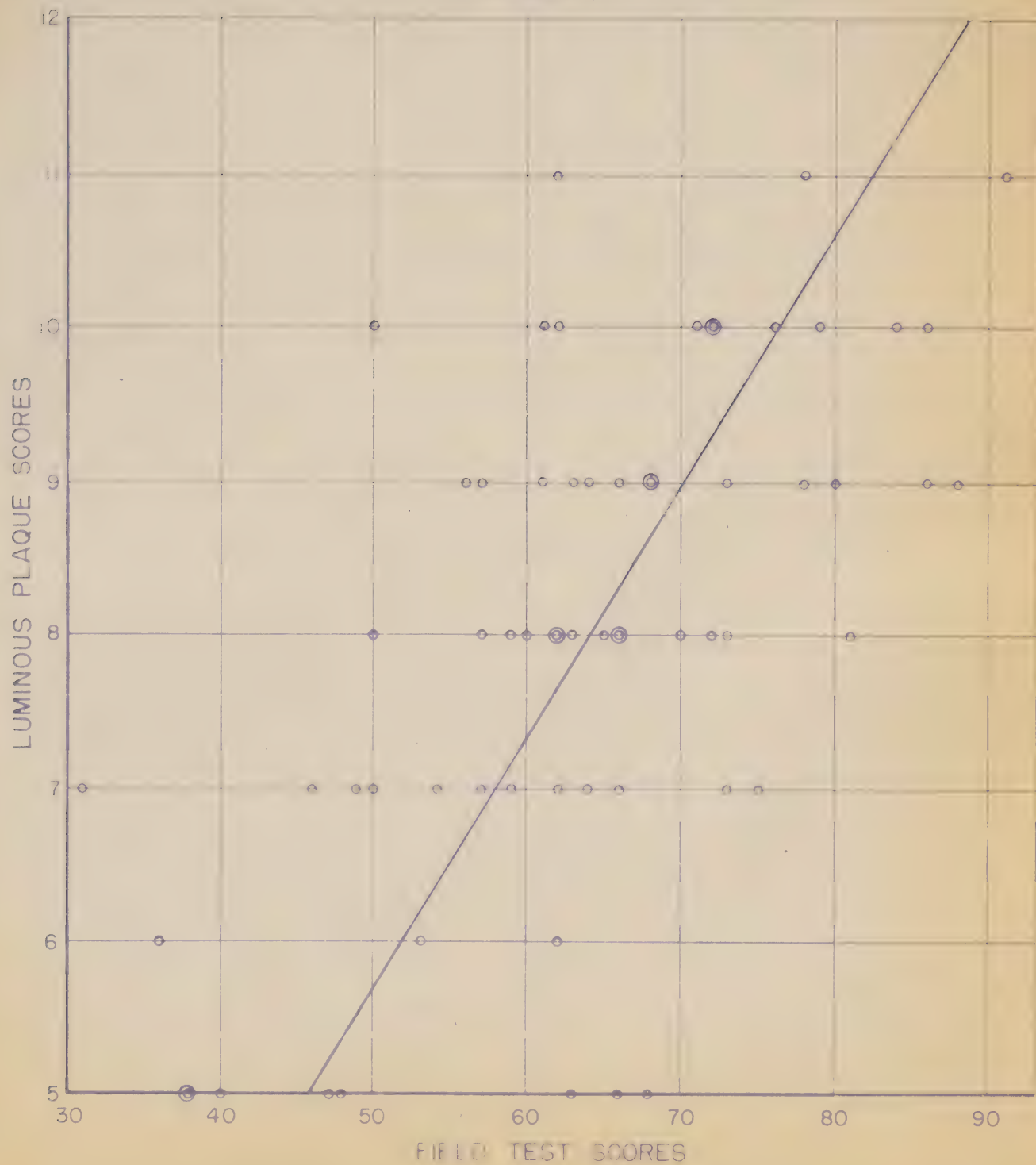
FIG. 28





FIG. 29

COMPARISON OF INDIVIDUAL LUMINOUS  
PLAQUE SCORES AND FIELD TEST SCORES  
( 64 MEN )



$r = 0.585$   
 $MF = 64.0$   
 $MLP = 8.0$

FIG. 29



FIG. 30

COMPARISON OF FIRST LUMINOUS  
PLAQUE TEST AND FIRST A.A.F. TEST  
(125 MEN)

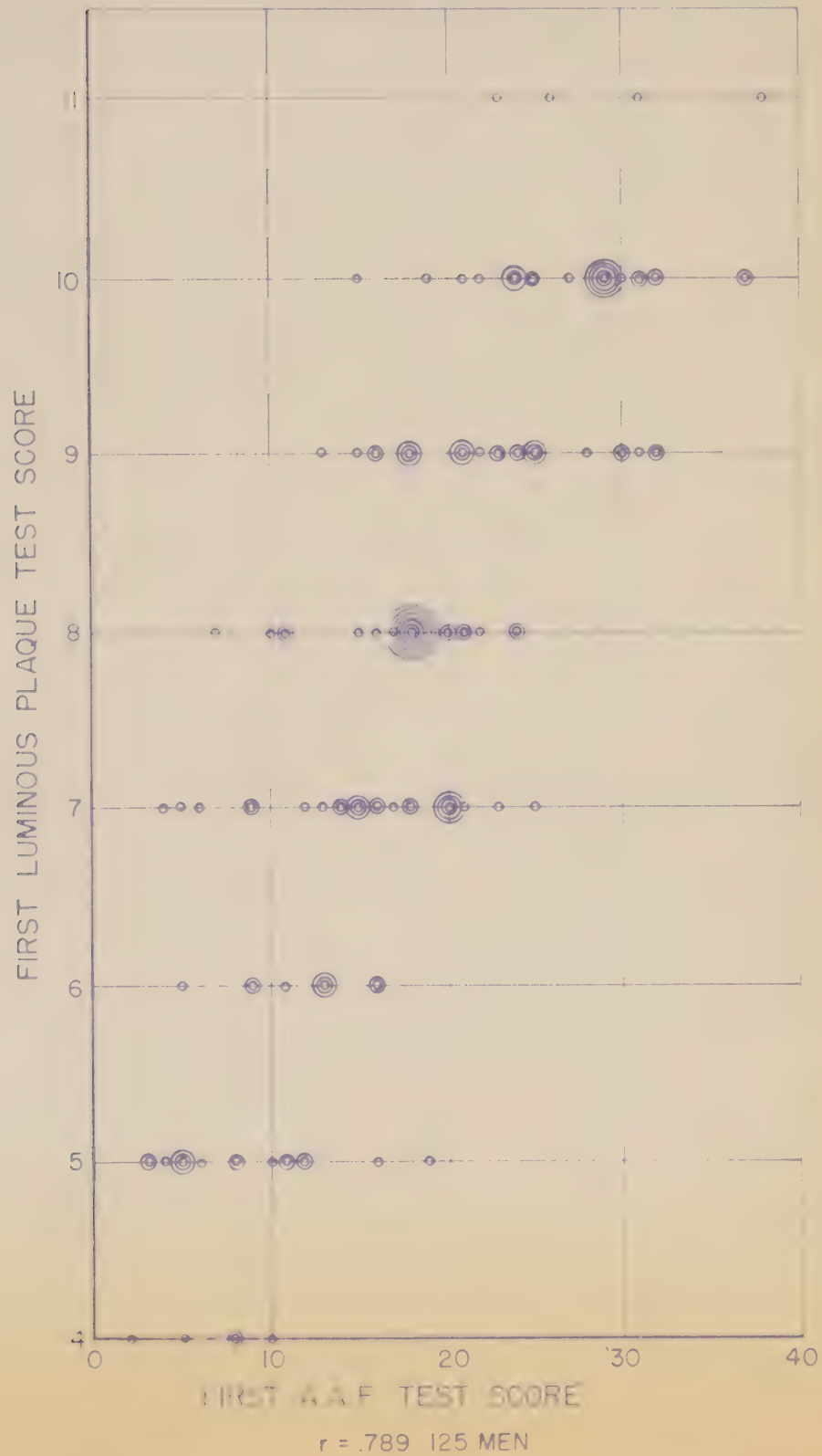


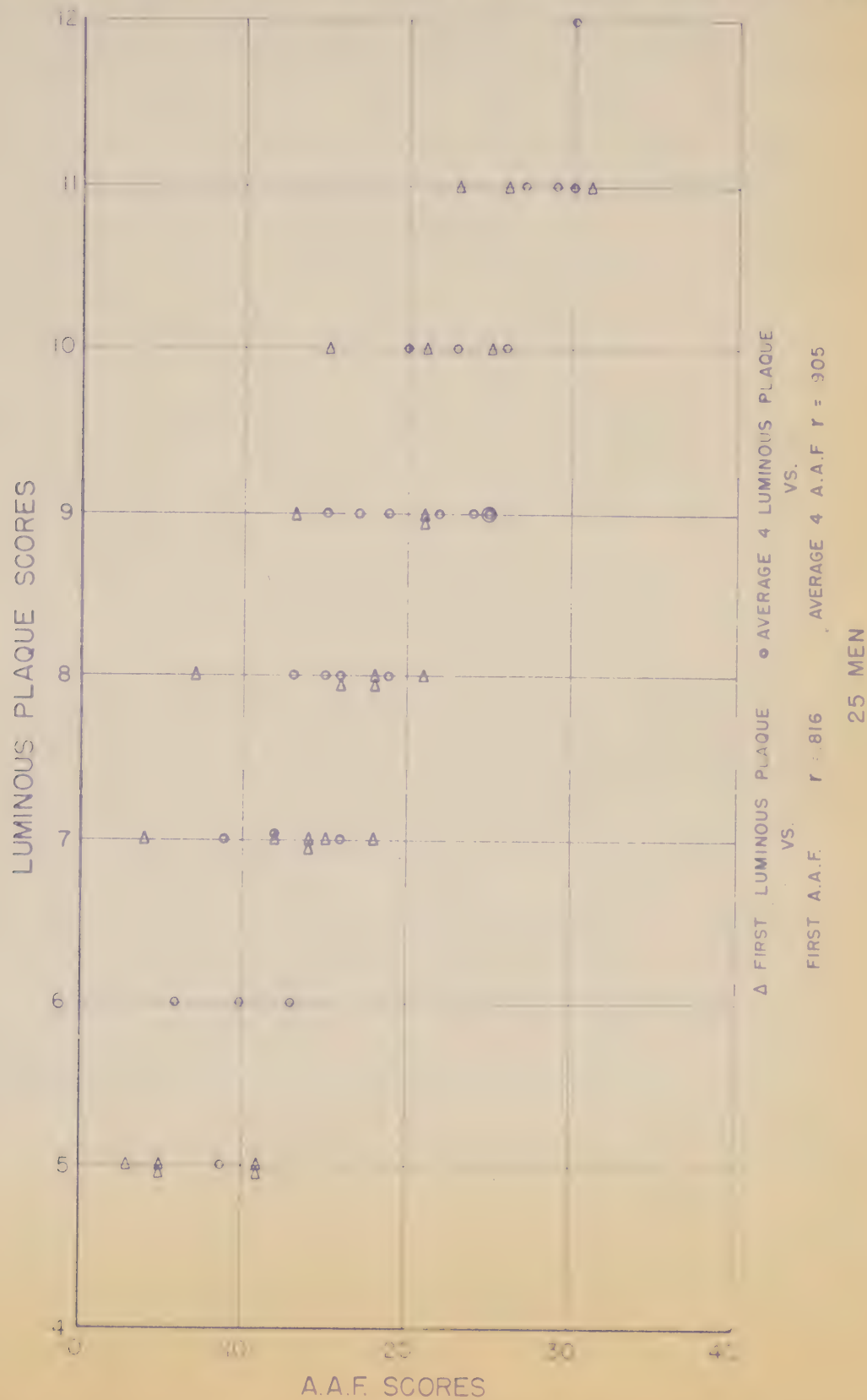
FIG. 30





FIG. 31

COMPARISON OF THE AVERAGES OF FOUR SUCCESSIVE LUMINOUS PLAQUE SCORES OF INDIVIDUAL MEN WITH THEIR AVERAGES FOR FOUR A.A.F. TESTS



h 3

FIG. 31



FIG. 33

PERCENT LOW, MIDDLE AND HIGH BY FIELD TEST FOR  
SELECTED LOWEST PERCENT BY LUMINOUS PLAQUE TEST

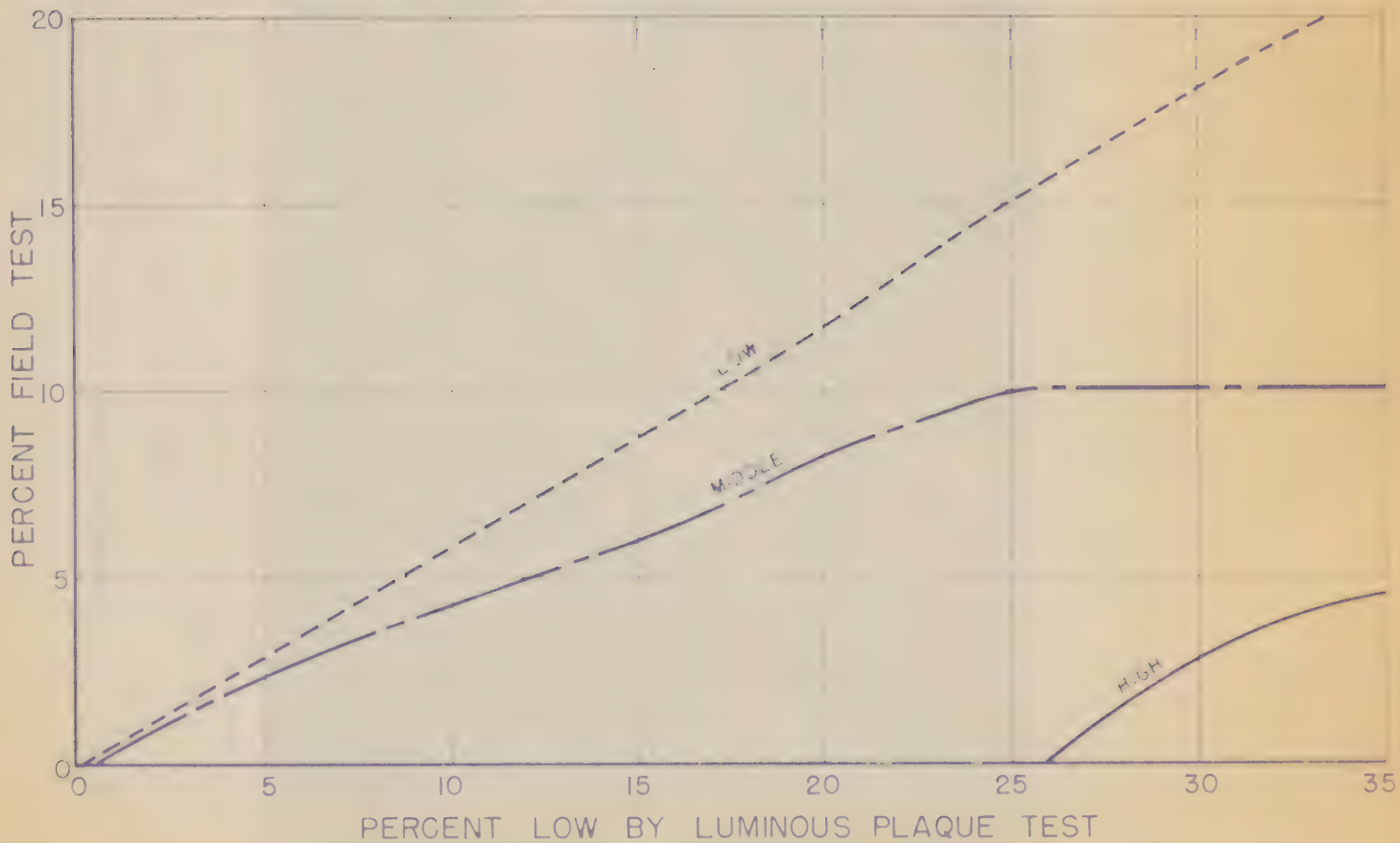


FIG. 33

ch. 243







1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

Project No. 7-8

GENERAL VIEW OF FIELD TEST AREA (All targets not shown)

#1





1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

Project No. 7-8

TYPICAL ARRANGEMENT OF FIELD TEST TARGETS (Note Guide Tape)

#2









Project No. 7-8

ARMORED MEDICAL RESEARCH LABORATORY  
FORT KNOX, KY.  
TYPICAL ARRANGEMENT OF FIELD TEST TARGETS

1 May 1944

#3





**ARMORED MEDICAL RESEARCH LABORATORY**

**FORT KNOX, KY.**

**Project No. 7-8**

**ILLUSTRATING POSITION OF OPERATOR DURING FIELD TEST**

**1 May 1944**

**#4**

1871





1 May 1944

**ARMORED MEDICAL RESEARCH LABORATORY**

FORT KNOX, KY.

Project No. 7-8

AAF TEST - SUBJECTS SEATED AT RECORDERS

#5

1871  
1872  
1873  
1874  
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1897  
1898  
1899  
1900



1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY  
FORT KNOX, KY.

Project No. 7-8

TARGET OF AAF TESTER

#6







1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

Project No. 7-8

LUCKIESH-MOSS TEST (Subject writes numbers and advances paper  
with crank not shown)

#7



LUCKIESH-MOSS LOW-CONTRAST TEST-CHART  
NELA PARK CLEVELAND

20	3 8	6 8	10
19	5 6	3 5	9
18	9 3	2 4	8
17	6 2	7 7	7
16	8 5	1 3	6
15	2 9	4 1	5
14	3 6	5 2	4
13	9 2	6 3	3
12	8 3	7 4	2
11	5 9	8 5	1

ARMORED MEDICAL RESEARCH LABORATORY  
FORT KNOX, KY.  
Project No. 7-8 LUCKIESH-MOSS TEST CHART

1 May 1944

#8







1 May 1944

**ARMORED MEDICAL RESEARCH LABORATORY**

FORT KNOX, KY.

**Project No. 7-8**

**S.A.M: TEST (Filters shown on front. Top disc only illuminated) #9**





1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

Project No. 7-8

REAR VIEW S.A.M. TESTER (Operator changes orientation of  
Landolt ring by rotation of fiber disc) #10





TOTAL DARKNESS

NIGHT VISION TESTER

PLAQUE

RADIUM



8

7

OPEN ONLY IN

TOTAL DARKNESS

RADIUM

PLAQUE

NIGHT VISION TESTER

Project No. 7-8

ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KY.

LUMINOUS PLAQUE TESTER

1 May 1944

#11

PHOTOGRAPH

-by-

SIGNAL CORPS, U. S. ARMY  
Fort Knox, Kentucky

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1 May 1944

ARMORED MEDICAL RESEARCH LABORATORY  
FORT KNOX, KY.

Project No. 7-8 LUMINOUS PLAQUE TEST (Showing measuring tape (Note tabs)

#12



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Fort Knox, Kentucky

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II

made